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Pulmonary prevention program in the Proszowice county: description and results

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Abstract

Introduction: In the Proszowice county, both lung cancer and chronic obstructive pulmonary disease (COPD) are more common in comparison with other regions of Poland. The purpose of this paper was to provide a report on a prevention program carried out in the area to reduce the burden of COPD and lung cancer in the region.

Material and methods: The program consisted of the following: active prevention — questionnaire survey offered to every county inhabitant aged at least 40 and chest X-ray and spirometry performed in selected subjects; and passive prevention — covering multiple educational activities promoting healthy lifestyle. Data obtained from questionnaire survey and spirometry were further analyzed.

Results: Education program covered all local children aged 13–15, a majority of adolescents and a significant proportion of adult inhabitants of the county. Questionnaire data were obtained from 14,455 subjects (about 70% of county inhabitants). On the basis of the questionnaire results, the participants were selected to undergo spirometry (5,816 subjects) and chest X-ray (5,514 subjects). Current smokers constituted 24.2% of the total number of participants (33.3% of men and 16.8% of women). Electronic cigarettes were currently used by 0.65% of the subjects. Negative impact of occupational exposures (including farming) on lung function and the presence of respiratory symptoms was observed. Basing on post-bronchodilator spirometry, COPD was diagnosed in 13.2% of the subjects. Physician's diagnosis of asthma was reported by 7.2%.

Conclusion: Educational activities and questionnaire-based study were targeted at and reached the majority of the county inhabitants. The study provided data on the prevalence and risk factors of COPD, asthma and respiratory symptoms in the Proszowice region.

Key words: COPD, lung cancer, prevention program

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Introduction

Lung diseases have a significant negative impact on the health status of the Polish population. From public health perspective, lung cancer and chronic obstructive pulmonary disease (COPD) are among the most important diseases. Lung cancer is the most common malignant neoplastic disease both in Poland [1, 2] and throughout the world [3]. COPD is one of the most widespread chronic respiratory diseases. In Poland and in Europe, clinically important COPD is present in at least 10% of population aged ≥ 40 [4, 5]. Worldwide, COPD is currently the fifth cause of the loss of DALYs (disability adjusted life years), causing large burden for healthcare budget as it is responsible for approximately 50% of total healthcare expenditures for lung diseases [6, 7].

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The Proszowice county demonstrates one of the highest lung cancer incidence and death rates in Poland (it ranks no. 21 out of 379 counties). This type of cancer accounts for approximately 27% of deaths due to malignant cancers in the area. Epidemiological COPD studies conducted in the said region also have demonstrated a high incidence of the disease. A survey carried out among active smokers aged ≥ 40 brought abnormal spirometry results (most often airflow obstruction) in approximately 1/3 of subjects and this result was significantly higher in comparison with that demonstrated by inhabitants of Krakow [8]. In 2007, in the county, international BOLD (Burden of Obstructive Lung Disease) study was organized following which COPD, according to the GOLD criteria, was found in 22.1% of adult subjects aged ≥ 40, and clinically significant state of disease (FEV_1 < 80% pred.) was found in 10.9% of subjects [4].

Following these results, one of the authors of this paper (WS) initiated a pulmonary disease prevention program targeted at the county inhabitants. Since both lung cancer and COPD are less frequent in persons under 40, the active prevention program was targeted at population aged ≥ 40.

Material and methods

The *Akcja Zdrowie — program profilaktyki i ochrony zdrowia nowotworów złośliwych oskrzeli i płuc na terenie powiatu proszowickiego* ("Action Health — lung cancer prophylaxis and health care improvement program") project consisted in the following: 1) active prevention program based on questionnaire survey, chest X-ray and spirometry carried out in selected participants, and 2) passive prevention program, covering multiple educational activities, aimed at improvement of health and lifestyle awareness of the county inhabitants.

Active prevention program

The program was targeted at all the inhabitants of the county (permanent residents) aged ≥ 40. The initial survey consisted of a questionnaire containing 24 questions concerning the following issues: basic demographic data (age, sex, education), exposure to known and potential risk factors (active smoking, passive smoking, use of electronic cigarettes), occupational hazards, exposure to asbestos, symptoms of respiratory diseases (dyspnea, cough, coughing up sputum, hemoptysis and weight loss) and previous medical diagnoses. Since nearly 88% of the county inhabitants are farmers, the questionnaire contained also questions concerning exposure to risks connected with farm work (use of plant protection products). The interviewers were trained by the medical project coordinator (WS). A pilot examination survey was undertaken in order to evaluate their work and after its completion, individual training was organized for the interviewers in order to eliminate any possible errors. In the course of the survey the work of the interviewers was supervised and evaluated by the medical project coordinator. The results of the survey were synchronously assessed with the use of a dedicated algorithm to calculate the risk of lung cancer and COPD. All answers to the questions were allocated a specific number of points, the total of which was the base for decision to qualify subjects for PA chest X-ray and spirometry (both pre- and post-bronchodilator). Spirometry was conducted with the use of Lungtest Handy and LungTest 1000 spirometers (produced by MES — Krakow, Poland). Spirometry was done by eight nurses trained by the producer of the spirometers and by the medical project coordinator.

All tests results were analyzed by a physician who assessed the need for further examination or treatment. The subjects reporting symptoms of lung cancer or those with other serious clinical/radiological problems were sent for urgent referral to a pulmonary specialist. Subjects requiring scheduled diagnostics were sent for planned check-ups. Further diagnostics was applied in cases of subjects who required it at the Pulmonary Outpatient Department of the Proszowice Hospital.

Passive prevention program

The program consisted of the following: (i) a series of educational meetings for children and young adults; (ii) a cycle of educational meetings for adults; (iii) sports tournaments and events; and (iv) education and promotion of healthy lifestyle in the media. The educational program was directed at children and young adults from primary and middle schools (age: 13–15 years). The information conveyed covered such issues as: healthy lifestyle, role of physical activity and sports, harmful effects of smoking tobacco, and were adjusted to the needs of the age group. Meetings for young people over 15 were arranged in secondary schools and secondary vocational schools. Issues similar to the mentioned above were addressed in a form adjusted to the needs of the age group. Educational meetings for adults were organized in all communes and villages of

the county. The role of healthy lifestyle, sports and diet was discussed, in addition to methods of smoking cessation, use of protective equipment in professional work, especially in farm tasks. A website was launched specifically for the program and internet chats were organized with physicians and other professionals specializing in healthy lifestyle. Educational meetings were run by trained medical educators in accordance with a specifically designed program.

Statistical analysis

Data qualified for statistical analysis were obtained from correctly completed surveys and spirometry results that met the ATS quality criteria. Chi-square test was used to compare the qualitative variables, if needed, with Yates' correction. Student t-test (for independent variables) or ANOVA tests were used to compare the quantitative variables. Linear multivariate analysis where potential predictors included the dependent variable as well as age, sex and tobacco smoking as potential predictors was used to assess the relationship of the analyzed exposures with respiratory symptoms and spirometry results.

Results

Active prevention program

Questionnaire data were obtained from 14,455 subjects amounting to approximately 70% of the adult population ≥ 40 of the county. Out of 14,455 surveys, data collected from 14,323 subjects were analyzed (98.4%). Spirometry data were collected from 5,816 subjects. Chest X-ray was conducted in 5,514 subjects (the rest presented normal chest X-rays taken in the preceding three months). Basic characteristics of the population analyzed are presented in Table 1.

Cigarette smokers proportion was 33.3% of men and 16.8% of women. The figure depended on education (smoking was most common among those with primary or vocational education) and age (the proportion of smokers was similar in persons aged 40–60 and thereafter decreased significantly with age). At the time of the survey, 0.65% of subjects (93 persons) were using electronic cigarettes (e-cigarettes). Further 3.47% (497 persons) had used these devices in the past. Most current and former users of e-cigarettes were current (70.3% and 84.3% respectively) or former smokers (26.4% and 13.5% respectively). Those exposed to passive smoking at the time of the survey constituted 21.0%, and those exposed to passive smoking in the past made up further 44.0% of the subjects.

Table 1. Basic characteristics of studied population

	Proportion of subjects (n) or mean (± SD)
Age, years, mean (± SD)	58.9 (± 11.8)
40–49	25.6 (3660)
50–59	27.7 (3966)
60–69	26.8 (3838)
≥ 70	19.9 (2849)
Sex	
Female	53.4 (7653)
Male	46.5 (6664)
Education	
Uncompleted primary	0.6 (87)
Primary	49.7 (7121)
Secondary	39.2 (5609)
College/university	7.2 (1025)
Smoking	
Current smokers	24.2 (3468)
Ex-smokers	25.3 (3627)
Never smokers	49.5 (7090)
Previous medical diagnoses	64.1 (9177)
Spirometry results	
Basic spirometry	
FEV_1*, mean (± SD)	96.2 (± 20.0)
FVC*, mean (± SD)	105.2 (± 20.8)
FEV_1/FVC, mean (± SD)	74.6 (± 9.2)
After bronchodilator (BD)	
FEV_1*, mean (± SD)	99.8 (± 19.6)
FVC*, mean (± SD)	106.8 (± 18.5)
FEV_1/FVC, mean (± SD)	76.3 (± 9.4)
FEV_1 improvement, % of pre-BD (± SD)	4.5 (± 9.8)
FEV_1 improvement, ml (± SD)	96.0 (± 200.5)

* % of predicted value

Among those who had never smoked these percentages amounted respectively to 16.8% and 46.2%. This type of exposure to tobacco smoke was statistically more common in women (current exposure 22.7% vs. 19.6%, in the past 47.5% vs. 41.0%; $p < 0.001$).

Table 2 presents lung function and selected respiratory symptoms depending on the exposure to tobacco smoke, use of e-cigarettes and occupation with potential exposure to hazardous inhalable substances. Table 3 shows the proportions of subjects using different types of heating and stoves in their houses and the same dependent

Table 2. FEV_1 and respiratory symptoms by exposure to tobacco smoke, e-cigarettes use and occupational risk factors

Exposure	Proportion of subjects (n)	FEV_1, % of predicted (SD)*	p**	Cough, % (n)	p***	Dyspnea, % (n)	p***
Total studied population	100.0 (14223)	99.8 (± 19.6)	–	9.3 (1333)	–	25.0 (3586)	–
Smoking	24.2 (3468)	97.8 (± 20.6)	< 0.001	14.7 (511)	< 0.001	25.9 (899)	< 0.001
E-cigarettes use	0.6 (93)	98.1 (± 18.9)	0.21	12.9 (12)	< 0.001	31.2 (29)	< 0.001
Currecnt exposure to second-hand smoke	21.0 (3008)	98.6 (± 19.7)	0.018	10.2 (307)	0.021	26.8 (807)	< 0.001
Occupational exposures							
Mining	1.0 (149)	94.8 (± 21.3)	0.070	20.8 (31)	< 0.001	33.6 (50)	0.016
Sand-blasting	0.2 (36)	94.1 (± 25.8)	0.413	33.3 (12)	< 0.001	38.9 (14)	0.055
Exposure to asbestos	0.6 (84)	96.8 (± 21.3)	0.384	17.7 (15)	0.012	39.3 (33)	0.002
Chemical industy	0.5 (72)	104.3 (± 21.6)	0.304	16.7 (12)	0.510	36.1 (26)	0.030
Milling	3.2 (459)	99.1 (± 20.6)	0.641	17.0 (78)	<0.001	33.3 (153)	< 0.001
Iron and steel industry	4.9 (695)	99.2 (± 19.7)	0.688	14.4 (100)	< 0.001	30.6 (213)	< 0.001
Welding	5.1 (724)	98.9 (± 16.7)	0.475	16.2 (117)	< 0.001	27.7 (201)	0.082
Fire-fighting	1.6 (222)	104.5 (± 19.4)	0.769	11.7 (26)	0.214	19.4 (43)	0.049
Farming	76.3 (10931)	99.2 (19.8)	< 0.001	6.5 (220)	< 0.001	19.0 (646)	< 0.001
Other professional exposure to chemicals	13.7 (1965)	100.2 (± 19.1)	0.512	11.4 (223)	0.001	31.0 (609)	< 0.001

* after bronchodilator; ** for comparison exposed vs non-exposed, student's T test; *** for comparison exposed vs non-exposed, chi^2 test with Yates' correction when appropriate

Table 3. Basic spirometry results

	Proportion of subjects [%]
Basic spirometry	
Normal spirometry	69.9
Aiflow obstruction	20.2
Suspected restriction ($FEV_1/FVC \geq 70\%$ + and $FVC < 80\%$)	4.8
Mixed abnormalities ($FEV_1/FVC < 70\%$ and $FVC < 80\%$)	4.2
Spirometry after bronchodilator administration	
COPD based on GOLD criteria ($FEV_1/FVC < 0.7$)	20.5
GOLD 1 ($FEV_1/FVC < 0.7$ and $FEV_1 \geq 80\%$ pred.)	10.9
GOLD 2 ($FEV_1/FVC < 0.7$ and $50\% \leq FEV_1 < 80\%$ pred.)	8.3
GOLD 3 ($FEV_1/FVC < 0.7$ and $30\% \leq FEV_1 < 50\%$ pred.)	1.3
GOLD 4 ($FEV_1/FVC < 0.7$ and $FEV_1 < 30\%$ pred.)	0.1
COPD based on PTCHP/ERS/ATS criteria ($FEV_1/FVC <$ LLN)	13.2

variables as above. An analysis of differences which in Table 2 were statistically significant in the multivariable analysis model, taking into account also tobacco smoking, age and sex, did not confirm independent influence of using e-cigarettes or work with asbestos, work in steel industry or other sectors with exposure to chemicals on the risk of cough. All other differences were independent of age, sex and tobacco smoking. The effect of tobacco smoking on lung function and the presence of symptoms did not depend on the age and sex of the subjects.

The basic results of spirometry are shown in Table 3. Basing on the Polish Society of Pul-

monary Diseases (PTChP) criteria ($FEV_1/FVC <$ LLN), COPD was diagnosed in 12.9% of women and 13.7% of men. Only 16.6% of persons with spirometrically diagnosed COPD (basing on the PTChP criteria) had been previously diagnosed with the disease. 7.2% of the subjects (1034) reported previous asthma diagnosis. Current smokers constituted 37.7% of the patients with irreversible airway obstruction and 16.2% of those with self-reported asthma diagnosis. Chest X-ray was performed in 5,514 subjects, i.e. 37.9% of the survey participants. Finally, as a result of the tests conducted (spirometry and chest X-ray examined by physicians), 0.75% (110) of persons were sent for urgent medical tests and further 10.9% (1582 persons) were sent for referral. Following the tests, lung cancer was histopathologically confirmed in 0.1% (14 persons) of subjects.

Passive prevention program

The passive prevention program included meetings in primary, middle and secondary schools in the county. The meetings were attended by all children aged 13–15 as well as by a significant number of the older youth. In all of the county schools, 134 educational meetings were organized. It is difficult to quote precise attendance figures but we may assume that since each meeting was attended by 15–25 persons then the total attendance figure ranged from 1,500 to 3,000. Nine internet chats were organized along with 12 large sports tournaments and events which were attended by a few thousand inhabitants of the county.

Discussion and conclusions

The most significant effect of the discussed program was obtaining data from 70% of inhabitants of the county aged 40 or older. This allowed to identify persons in need of medical diagnostics and provided a credible analysis of risk factors causing impaired lung function and an increased risk of respiratory symptoms.

In comparison to a survey conducted in the Małopolska region 10 years before, the percentage of smokers decreased by 4% [4]. Smoking frequency in the surveyed area is similar to that found in other rural areas of Poland [9]. The use of e-cigarettes emerged as a new problem. However, the results of our survey show that these devices have been used by a small percentage of the subjects, ca. 4% in total, which is far less than average for the Polish population [10]. It is possible that this difference is related to the age of the population surveyed as most e-cigarette users are young and middle-aged people. The devices have been used mostly by smokers, which has been confirmed by previous data [11] and allows to hope that in the ≥ 40 age group, e-cigarettes are actually seen as device helping in smoking cessation. The study survey did not comprise young individuals and in this group, the risk that e-cigarettes use could promote smoking is probably the biggest.

As predicted, the exposure to known respiratory risk factors was related to an impaired lung function and a higher prevalence of symptoms. These results have been confirmed by data from multiple previous publications [7, 12, 13]. The effect of occupational exposures on increased COPD risk and the presence of respiratory symptoms has been known for many years, and the American Thoracic Society has stated that occupational risks are responsible for approx. 20% of cases of COPD [4, 14, 15]. Detailed analysis of COPD risk factors among farmers will be presented in a separate paper. An independent influence of the use of e-cigarettes on the studied variables has not been confirmed in our study. The use of these devices (used mainly by smokers often for a short term "testing") further suggests that other results would be implausible.

The proportion of asthma diagnosis reported by the subjects is slightly higher than that reported by the subjects of the ECAP survey in Małopolska [16] but closer to a survey including analysis of the results by a physician (7.6% [6.0–9.1%]) [17]. Small differences result probably from different age ranges of the populations surveyed. The proportion of subjects with abnormal spirometry results is similar to one reported in the previous spirometry-based epidemiological study held in the county [8]. The prevalence of COPD diagnoses on the basis of GOLD and PTChP/ERS/ATS criteria shows significant differences (20.5% *v.* 13.2%). The GOLD criterion has been criticized because it leads to significant overdiagnosis of COPD in elderly people and insufficient number of diagnoses in younger subjects (especially smokers) [18]. Therefore, many prestigious scientific societies, including the Polish Respiratory Society, advise to use the LLN of the FEV_1/FVC ratio as cut-off threshold [19]. The percentage of tobacco smokers among patients with diagnosed respiratory diseases is a major source of concern. Even more worrying is the situation among those with spirometrically diagnosed COPD out of whom 36% were current smokers and a majority were not aware of their condition.

This study has some limitations. Like every cross-sectional study, also this work does not

allow to formulate conclusions on causability of observed relationships. Confirmed relation of lung function and respiratory symptoms with risk factors can be affected by confounding factors which have not been included in the survey questionnaire. However, the large size of the sample group from the same small area (ca. 70% of population aged ≥ 40 was surveyed) and the high proportion of subjects who gave their consent for participation considerably increase the credibility of the results presented [20].

Spirometry conducted in subjects exposed to risk factors allowed to identify approx. 1800 patients with some degree of ventilatory defects. Spirometry should not be used as screening test for general population [21], but according to the GOLD guidelines, it is an effective diagnostic tool for patients with respiratory symptoms or those exposed to risk factors [7]. Unfortunately, in spite of the efforts of the author of the project (WS), low-dose computed tomography could have not been included as a part of the survey. For this reason, the program cannot be viewed as a typical lung cancer screening test because only computer tomography is an effective screening tool for lung cancer prevention [22, 23]. Therefore, the use of a risk assessment questionnaire was pre-planned with additional diagnostic tests when appropriate (in subjects in whom risk assessment demonstrated higher risk) [24]. Thus chest X-ray has not been used as a screening test exclusively but rather as an element of the program allowing the inhabitants a wider access to lung disease diagnostics.

The organizers of the project hope that it will result in a decrease in smoking and improve physical activity among young people. According to the Central Statistical Office of Poland (GUS), approximately 10% of boys and 5% of girls aged 15–19 smoke cigarettes every day and only about a half of school-aged children does regular physical activity outside school [25]. The organizers also hope that a higher proportion of adult subjects would eventually quit or consider quitting smoking and avoid exposure to risks occurring during farm work as well as and promote correct application of herbicides/pesticides and fertilizers (these are used by ca. 80% of the farmers surveyed, usually without sufficient protection of the respiratory system).

In summary, the program has provided information on the prevalence of respiratory diseases and risk factors present among the county population. The conducted screening tests allowed to identify subjects with respiratory symptoms and those exposed to respiratory risk factors and provide them with appropriate diagnostics and treatment.

Conflict of interest:

The authors declare do conflict of interest.

Both WS and FM contributed equally to this work.

References:

1. Radziszewska A, Karczmarek-Borowska B, Grądalska-Lampart M, et al. Lung cancer in Podkarpackie region in the years 2002-2011. Pneumonol Alergol Pol. 2015; 83(2): 109–119, doi: 10.5603/PiAP.2015.0018, indexed in Pubmed: 25754052.
2. Wojciechowska U, Didkowska J. Zachorowania i zgony na nowotwory złośliwe w Polsce. Krajowy Rejestr Nowotworów, Centrum Onkologii - Instytut im. Marii Skłodowskiej-Curie. Dostępne na stronie http://onkologia.org. pl/raporty/dostęp z dnia 01.03.2017.
3. Didkowska J, Wojciechowska U, Mańczuk M, et al. Lung cancer epidemiology: contemporary and future challenges worldwide. Ann Transl Med. 2016; 4(8): 150, doi: 10.21037/atm.2016.03.11, indexed in Pubmed: 27195268.
4. Nizankowska-Mogilnicka E, Mejza F, Buist AS, et al. Prevalence of COPD and tobacco smoking in Malopolska region--results from the BOLD study in Poland. Pol Arch Med Wewn. 2007; 117(9): 402–410, indexed in Pubmed: 18062562.
5. Buist AS, McBurnie MA, Vollmer WM, et al. BOLD Collaborative Research Group. International variation in the prevalence of COPD (the BOLD Study): a population-based prevalence study. Lancet. 2007; 370(9589): 741–750, doi: 10.1016/S0140-6736(07)61377-4, indexed in Pubmed: 17765523.
6. Murray CJL, Barber RM, Foreman KJ, et al. GBD 2013 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries, 1990-2013: quantifying the epidemiological transition. Lancet. 2015; 386(10009): 2145–2191, doi: 10.1016/S0140-6736(15)61340-X, indexed in Pubmed: 26321261.
7. GOLD (Global Initiative for Chronic Obstructive Lung Disease) 2017. Pneumologie. 2017; 71(01): 9–14, doi: 10.1055/s-0042-121903.
8. Krawczyk K, Skucha W. [Incidence of chronic obstructive pulmonary disease among chronic smokers inhabiting Krakow and Proszowice]. Przegl Lek. 2000; 57(11): 617–618, indexed in Pubmed: 11293207.
9. Włodarczyk A, Raciborski F, Opoczyńska D, et al. GATS PWG. Daily tobacco smoking patterns in rural and urban areas of Poland--the results of the GATS study. Ann Agric Environ Med. 2013; 20(3): 588–594, indexed in Pubmed: 24069871.
10. Filippidis FT, Laverty AA, Gerovasili V, et al. Two-year trends and predictors of e-cigarette use in 27 European Union member states. Tob Control. 2017; 26(1): 98–104, doi: 10.1136/tobaccocontrol-2015-052771, indexed in Pubmed: 27220621.
11. Grana R, Benowitz N, Glantz S, et al. E-cigarettes: a scientific review. Circulation. 2014; 129(19): 1972–1986, doi: 10.1161/CIRCULATIONAHA.114.007667, indexed in Pubmed: 24821826.
12. Eisner MD, Anthonisen N, Coultas D, et al. Committee on Nonsmoking COPD, Environmental and Occupational Health Assembly. An official American Thoracic Society public policy statement: Novel risk factors and the global burden of chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2010; 182(5): 693–718, doi: 10.1164/rccm.200811-1757ST, indexed in Pubmed: 20802169.
13. Lamprecht B, Schirnhofer L, Kaiser B, et al. Farming and the prevalence of non-reversible airways obstruction: results from a population-based study. Am J Ind Med. 2007; 50(6): 421–426, doi: 10.1002/ajim.20470, indexed in Pubmed: 17497693.
14. Salvi SS, Barnes PJ. Chronic obstructive pulmonary disease in non-smokers. Lancet. 2009; 374(9691): 733–743, doi: 10.1016/S0140-6736(09)61303-9, indexed in Pubmed: 19716966.
15. Fishwick D, Barber CM, Darby AC. Chronic Obstructive Pulmonary Disease and the workplace. Chron Respir Dis. 2010; 7(2): 113–122, doi: 10.1177/1479972309354690, indexed in Pubmed: 20185481.

16. Zalewska M, Furmańczyk K, Jaworski S, et al. The prevalence of asthma and declared asthma in Poland on the basis of ECAP survey using correspondence analysis. Comput Math Methods Med. 2013; 2013: 597845, doi: 10.1155/2013/597845, indexed in Pubmed: 23401722.
17. Liebhart J, Malolepszy J, Wojtyniak B, et al. Polish Multicentre Study of Epidemiology of Allergic Diseases. Prevalence and risk factors for asthma in Poland: results from the PMSEAD study. J Investig Allergol Clin Immunol. 2007; 17(6): 367–374, indexed in Pubmed: 18088018.
18. Quanjer PH, Enright PL, Miller MR, et al. The need to change the method for defining mild airway obstruction. Eur Respir J. 2011; 37(3): 720–722, doi: 10.1183/09031936.00135110, indexed in Pubmed: 21357929.
19. Śliwiński P, Górecka D, Jassem E, et al. Zalecenia Polskiego Towarzystwa Chorób Płuc dotyczące rozpoznawania i leczenia przewlekłej obturacyjnej choroby płuc. Pneumonologia i Alergologia Polska. 2014; 82(3): 227–263, doi: 10.5603/piap.2014.0030.
20. Hennekens CH, Buring JE. Epidemiology in Medicine. Lippincott Williams & Wilkins 1987.
21. Siu AL, Bibbins-Domingo K, Grossman DC, et al. US Preventive Services Task Force (USPSTF). Screening for Chronic Obstructive Pulmonary Disease: US Preventive Services Task Force Recommendation Statement. JAMA. 2016; 315(13): 1372–1377, doi: 10.1001/jama.2016.2638, indexed in Pubmed: 27046365.
22. Aberle DR, Adams AM, Berg CD, et al. National Lung Screening Trial Research Team. Reduced lung-cancer mortality with low-dose computed tomographic screening. N Engl J Med. 2011; 365(5): 395–409, doi: 10.1056/NEJMoa1102873, indexed in Pubmed: 21714641.
23. Kauczor HU, Bonomo L, Gaga M, et al. European Society of Radiology (ESR), European Respiratory Society (ERS), European Society of Radiology (ESR), European Respiratory Society (ERS). ESR/ERS white paper on lung cancer screening. Eur Radiol. 2015; 25(9): 2519–2531, doi: 10.1007/s00330-015-3697-0, indexed in Pubmed: 25929939.
24. Hamilton W, Green T, Martins T, et al. Evaluation of risk assessment tools for suspected cancer in general practice: a cohort study. Br J Gen Pract. 2013; 63(606): e30–e36, doi: 10.3399/bjgp13X660751, indexed in Pubmed: 23336455.
25. Piekarzewska M, Wieczorkowski R. Zajenkowska-Kozłowska A. Stan zdrowia ludności Polski. Główny Urząd Statystyczny Warszawa. 2016.