

Chudzik Robert, Rybojad Pawel. The number of passively smoked cigarettes and the risk of lung cancer among the inhabitants of the Świętokrzyskie Region (2010-2018). *Journal of Education, Health and Sport*. 2021;11(9):344-350. eISSN 2391-8306. DOI <http://dx.doi.org/10.12775/JEHS.2021.11.09.043> <https://apcz.umk.pl/JEHS/article/view/JEHS.2021.11.09.043> <https://zenodo.org/record/5518202>

The journal has had 5 points in Ministry of Science and Higher Education parametric evaluation. § 8. 2) and § 12. 1. 2) 22.02.2019.

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The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 13.09.2021. Revised: 20.09.2021. Accepted: 21.09.2021.

The number of passively smoked cigarettes and the risk of lung cancer among the inhabitants of the Świętokrzyskie Region (2010-2018)

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Abstract

Air purity is one of the factors affecting human health. Over the years, numerous scientific reports have provided us with evidence of the effects of air pollution on health. Along with the increase in pollution, the risk of respiratory and circulatory diseases in particular increases. The main pollutants are Airborne particulate matters (PM) which, depending on the size, vary between 2.5 and 10. Their presence is mainly related to the burning of fossil fuels. Another significant air pollutant is NO₂, mainly related to road transport. It is believed that the long term exposure to NO₂ could increase inflammation. The negative effect of air pollution is also associated with an increased frequency of strokes, exacerbations of mental illnesses and also with diseases of the digestive system.

We analyzed the data available in the Polish National Cancer Registry (PNCR), Chief Inspectorate for Environmental Protection and Air Quality Guidelines, We checked air pollution by the means of PM_{2.5}, PM₁₀ and NO₂ and thanks to mathematical equation delivered by Saskia C. van der Zee converted them into number of passively smoked cigarettes. Above data we compared to lung cancer morbidity in Świętokrzyskie Region.

Based on the latest published data, we can infer that in 2010-2018 each citizen of Świętokrzyskie Region smoked average 9,8 cigarettes a day +/- 2,3. The incidence of lung cancer is more or less the same number with a slight upward trend. After 61 years everyone in the exanimated region had 30 package-years of passive smoking and high risk of lung cancer. Air quality in Poland is not rewarding, exceeding WHO Guidelines 2005 recommendations translates into an increased risk of respiratory and cardiovascular diseases.

Key words: Lung cancer; Air pollution; PM; NO₂

INTRODUCTION

Air cleanliness is recognized as one of the important parameters of health and welfare criteria. The World Health Organization has been dealing with the topic of air quality since 1987, when the first guidelines on standards and norms for pollution were issued. Since then, many scientific studies on the harmfulness of numerous substances which are largely the result of our activities, especially the development of technology and industry have been created. Since the first guidelines, the public has realized how important it is to care for the quality of the surrounding environment. This issue is gaining importance all the time.

As a result of exposure to air pollution, the risk of cancer and cardiovascular diseases increased by 30% between 1990 and 2013. Recently, cancer is one of the leading causes of death in the world. In 2012r. lung cancer was the most common cancer in men; in women, it is the third most common cancer, after breast and rectum. According to the latest available data, also in Poland, lung cancer is the most common in men; women only breast cancer is more common. This is one of the most aggressive cancers that have proven no effective screening. 5-year average survival is 10-15% - On the world It's the main cause of death among cancers in men and the second in women. In Poland lung cancer have the highest mortality in both sexes. That makes it an important research object, both in treatment and reduction of morbidity. There is a large and growing literature that provides compelling evidence about factors that contribute to the development of lung cancer. One of the main themes is smoking tobacco, also passive. In addition, exposure to asbestos, radon, polycyclic aromatic hydrocarbons, crystalline silica. Rarely when we tell about lung cancer, we mention also about PM 2,5 PM 10 , cars exhaust, which are components of NO₂, what has important place in carcinogenesis.

Nitrogen oxides mainly represented by nitrogen dioxide are pollutants mainly attributed to road transport. Nitrogen dioxide, or NO₂, is a gaseous air pollutant composed of nitrogen and oxygen and is one of a group of related gases called nitrogen oxides, or NO_x. NO₂ forms when fossil fuels such as coal, oil, gas or diesel are burned at high temperatures. NO₂ and other nitrogen oxides in the outdoor air contribute to particle pollution. Nitrogen dioxide causes a range of harmful effects on the lungs, including: Increased inflammation of the airways; Reduced lung function; Increased asthma attacks; New research warns that NO₂ is likely to be a cause of asthma in children.

PM stands for particulate matter (also called particle pollution): the term for a mixture of organic and inorganic solid particles and liquid droplets found in the air. There are two most common types: PM 10 - particles up to 10 micrometers in diameter - can reach the upper respiratory tract and lungs. PM 2.5 are particles with a diameter of up to 2.5 micrometers. Due to their small size they can get not only into the lungs, but also into the circulatory system.

Particle pollution can come from two different kinds of sources — primary or secondary. Primary sources cause particle pollution on their own. For example, wood stoves and forest fires are primary sources. Secondary sources let off gases that can form particles. Power plants and coal fires are examples of secondary sources. Some other common sources of particle pollution can be either primary or secondary — for example, factories, cars and trucks, and construction sites. Smoke from fires and emissions (releases) from power plants, industrial facilities, and cars and trucks contain PM_{2.5}.

The numerous consequences of exposure to these aerosol matters include: circulatory arrhythmias, ischemic stroke, respiratory system disorders: sore throat, cough, exacerbation of COPD, lung cancer.

Due to the nature and authority of the organization, when writing about air quality, we refer in many places to the standards of the World Health Organization issued in 2005. Other standard proposals that we could take into account were the guidelines adopted by the European Commission under Directive 2008/50 / EC of 2008 and the Regulation of the Ministry of the Environment of Poland of 2012 (Journal of Laws of 2012, item 1032). Unfortunately, these values are more liberal than those proposed by the WHO.

The importance of PM, NO₂, as well as other air pollutants is important, especially keeping in mind that 10-25% of all lung cancers occur in people who have never smoked cigarettes. [1,2,3,4,5,6]

MATERIALS AND METHOD

We started our work by query of literature on air pollution and its relationship to neoplasms, especially to lung cancer. Then we analyzed the guidelines for air pollutants presented by WHO in 2015, we compared them to the Polish Environmental Protection Law published April 27, 2001. Measurement values of air pollutants (PM 2.5; PM10; NO₂) for Poland in 2010-2018 were taken from the database of the Chief Inspectorate for Environmental Protection. Presented values of PM_{2.5} are the average of 24h survey gathered from all measurement stations in Świętokrzyskie Region. The completeness of the measurements is over 90%. In the case of NO₂, the annual average values based on survey performed every 1 hour from all measurement points in Świętokrzyskie Region. In individual years, there was a different number of operating measuring stations - this may affect the credibility of the data. The number of cases and the cumulative risk for lung cancer (ICD10 - C34) were reported by the National Cancer Registry (2010-2018). Statistical studies were carried out using a Statistica. [2,4,7,8,9]

Based on the available data, using the formula prepared by Saskia C. van der Zee, Paul H. Fischer, Gerard Hoek in the work "Air pollution in perspective: Health risks of air pollution expressed in equivalent numbers of passively smoked cigarettes" [10], we converted average concentrations of PM 2,5 and NO₂ into number of passively smoked cigarettes (per day) by residents of Świętokrzyskie Region during the period of one year.

The latest available data from the Chief Inspectorate for Environmental Protection come from 2019, however, due to the fact that in the case of the National Cancer Registry, these are data from 2018, this study does not include 2019.

RESULTS

The etiology of lung cancer is multifactorial. We focused on air pollution and its influence on lung neoplasms. The formula for calculating passively smoked cigarettes contains black carbon in its formula. This substance is not measured by Polish measuring stations, instead elemental carbon is measured - which is not an exact representation. WHO has published reference values for many air pollutants, including the following: PM 2.5; PM 10; NO₂. [] It is worth to notice that the European Commission also published its proposals for standards, which, however, are more liberal than those proposed by WHO.

The standards for Poland provided by the 2001 Environmental Protection Law are similar to the European ones. [] Standarts proposed by European Commission and individual countries are often corrected by economic issues while WHO focuses its activities on health problems and that is why its norms are more restrictive. It is also worth noting that Polish and European standards allow for exceedances of measurements, WHO, due to the pro-health nature of the standards, does not allow for exceedances.

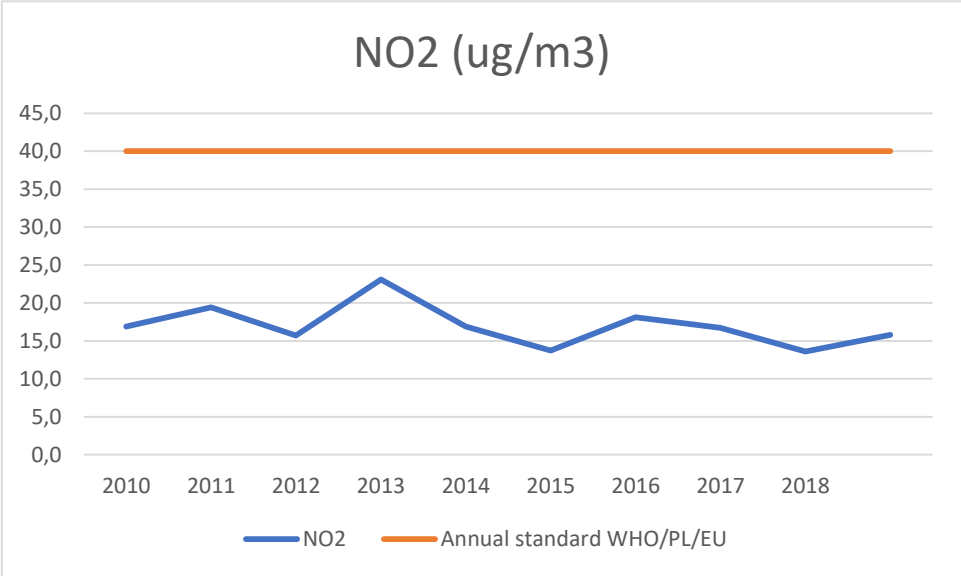


Figure 1. Average annual concentration of NO2

We can observe the maintenance of the average annual NO2 concentration at a similar level. Fluctuations in concentration may be dictated by the number of measuring stations in operation. According to the available GIOS data, the number of measuring stations has changed over the years. The guidelines on the permissible concentration of this pollutant provided by WHO, Poland and Europe have been met for years.

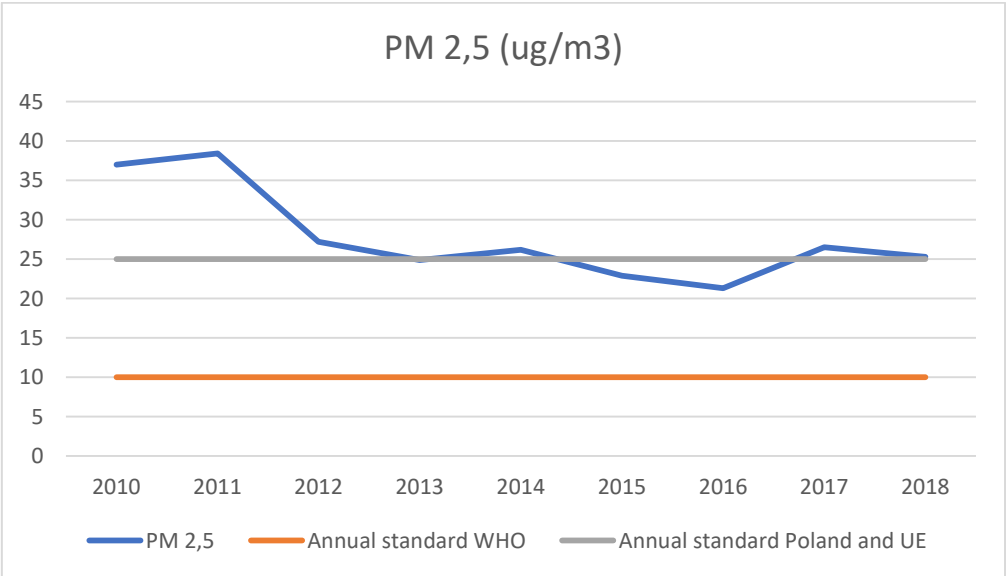


Figure 2. Average annual concentration of PM 2,5

We can observe a decrease in the concentration of PM 2.5 over the studied years. Unfortunately, despite this positive trend, not only the restrictive WHO standards are exceeded. The standards in force in accordance with Polish and European law are also periodically exceeded.

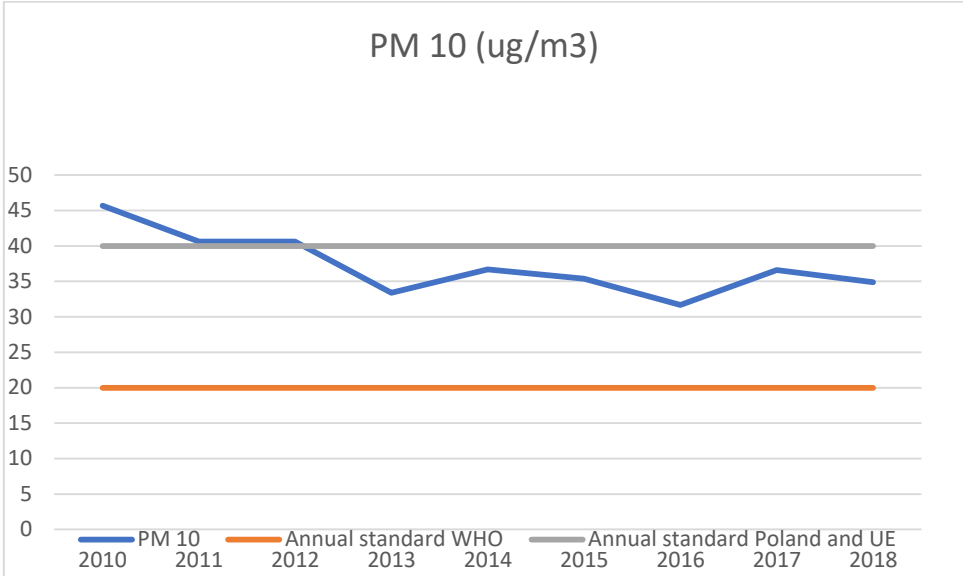


Figure 3. Average annual concentration of PM 10

Since 2010, the concentration of PM 10 has been decreasing. We can notice that since 2013 Polish and European standards have been complied with, and the concentration remains at a similar level. Unfortunately, the maintained level is inconsistent with the WHO guidelines, which are still exceeded.

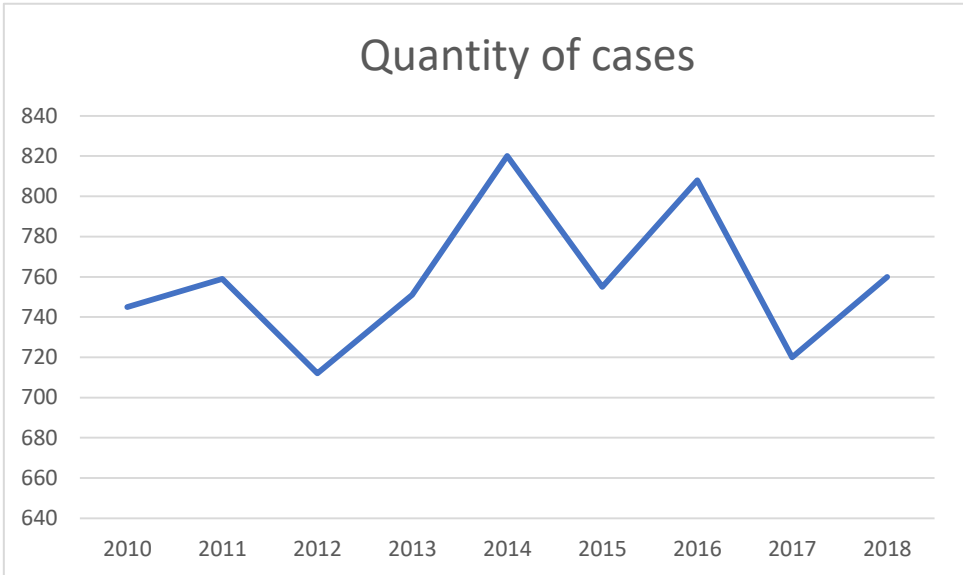


Figure 4. Quantity of cases C33

Over the years 2010-2018, the number of lung cancer cases fluctuated. Ultimately, in the analyzed period, we can observe an upward trend.

Table 1. Calculated amount of ‘passively’ smoked cigarettes

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Calculated amount of ‘passively’ smoked cigarette	12,6	12,5	10,4	9	8,9	8,6	8	9	8,9
+/-	3,1	3,2	2,3	2,1	2,2	1,9	1,8	2,2	2,1

In the analyzed years, based on the formula proposed by Saskia C. van der Zee et al. we calculated that air pollution with PM 2.5 and NO₂ is responsible for passive smoking of approximately 0.5 packs of cigarettes a day. Therefore, after the age of 61, every inhabitant of the Świętokrzyskie Region has unconsciously smoked out 30 pack-years, which is a significant factor increasing the risk of lung cancer incidence.

DISCUSSION:

The quality of the air we breathe requires constant attention. Both taking into account the Świętokrzyskie Region and the whole country. Our study showed that in the studied region, NO₂ remains relatively constant in accordance with WHO standards and the provisions of Polish and European law. By contrast, for PM_{2,5} and PM₁₀, despite an initial decrease over the period considered, they are now at a similar level. This level does not meet the WHO recommendations and, as in the case of PM 2.5, it fluctuates within the limits of the regulations. Due to the movements of air masses, analyzes based only on the sources of pollution in the studied area may be incomplete. Similarly, the analysis of lung cancer cases with intensive migration of people both within the country and the world is subject to certain limitations.

In this study, we drew attention to the persistent problem of lung cancer incidence, due to the multifactorial genesis of neoplastic diseases, we cannot fully blame one factor - air pollution despite that how many substances formed it. Air pollution may not only increase the risk of incidence, but also worsen the prognosis of existing diseases. After consideration the above data, it seems reasonable to introduce screening tests for lung cancer - which would allow earlier and more beneficial treatment.

Air pollution data is from before the COVID-19 epidemic, i.e. the period of significant restrictions on industry and road transport, i.e. the main sources of, among others, NO₂, it is reasonable to compare the obtained results with the data from the COVID-19 epidemic period.

However, nothing will be able to replace the simplest method of fighting neoplastic diseases- education and prevention. We should increase awareness of risk factors and discourage smoking - especially when each of us realizes that we passively smoke 0.5 package a day. Promotion of a healthy lifestyle will be beneficial both in the prevention of neoplastic diseases and in qualifying for treatment. [2,4,11,12]

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