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Original research

# Influence of industrial atmospheric pollution on the development of pathology of respiratory organs

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of the article

Due to the technogenic load, first of all, the quality of the air basin is disturbed. More than 80 % of diseases depend to some extent on its quality, but in an industrial city, atmospheric pollution determines the priority of pathology of respiratory organs.

**The purpose** of the work was to study the peculiarities of the development of pathological conditions of the respiratory organs in the population living in conditions of significant atmospheric pollution.

**Materials and methods.** Industrial emissions into the air basin from enterprises of the metallurgical industry were investigated. The type of violations of ventilation functions (obstruction, restriction, obstruction on the background of restriction) was determined from the "flow – volume" curve of the forced expiration. The incidence was studied according to the statistical materials of hospitals.

**Results.** The residents of the industrial city have a complex of ecotoxicants, which leads to a dangerous degree of pollution and a very contaminated level. In 53.8 % of the city's residents there are deviations in the ventilation function (by the method of the flow - volume curve analysis) due to the development of obstructive changes in the bronchopulmonary apparatus of the upper respiratory tract. After 49 years of living in such conditions, nearly in all the population prenosological conditions are registered (91.7–93.9 %). With prolonged residence in conditions of contamination, obstruction significantly increases against the background of restriction. The incidence of respiratory diseases in adults is higher with a high level of use of production capacity.

**Conclusions.** In 53.8 % of the inhabitants of the industrial city, there are deviations in the ventilation function due to the development of obstructive changes in the broncho-pulmonary apparatus of the upper respiratory tract (obstruction combined with a restriction and obstruction).

With age, the proportion of persons with prenosological conditions of respiratory function increases, especially at the age of 30–39 and 40–49 years. A high degree correlation exists between air pollution and population morbidity. Thus, the correlation coefficient between the total city air pollution indexes and respiratory diseases is 0.72 ($P < 0.01$) in adults and 0.66 ($P < 0.05$) in children.

The morbidity of the adult population of the megapolis with diseases of the respiratory organs has waved in the last years. The trend of its dynamics was $y = 3343.2 – 47.97x$, with a coefficient of multiple correlation of 0.78 ($P < 0.05$). The regularities of long-term chromodynamics of respiratory organs incidence among children is almost the same as at high and at a moderate level of industrial production - dynamics tendency has a look of equation $y = 10190.3 – 41.2x$ and $y = 8813.9–76.3x$ with a coefficient of multiple correlation 0.59–0.64 ($P < 0.05$).

**Key words:** air pollution, respiratory tract diseases, hygienic prenosological diagnostics.

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## Вплив індустріальних атмосферних забруднень на розвиток патології органів дихання

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Унаслідок техногенного навантаження передусім порушується якість повітряного басейну. Понад 80 % захворювань так чи інакше залежать від його якості, але у промисловому місті атмосферні забруднення зумовлюють пріоритетне місце патології органів дихання.

**Мета роботи –** вивчити особливості розвитку патологічних станів органів дихання в населення, що проживає в умовах істотних атмосферних забруднень.

**Матеріали та методи.** Дослідили промислові викиди в повітряний басейн від підприємств металургійної галузі. За кривою «потік – об'єм» форсованого видиху визначали тип порушень вентиляційної функції (обструкція, рестрикція, обструкція на тлі рестрикції). Захворюваність вивчали за статистичними матеріалами лікарень.

**Результати.** На жителів промислового міста діє комплекс екотоксикантів, що зумовлює небезпечний ступінь забруднення та дуже забруднений рівень. У 53,8 % містян є відхилення вентиляційної функції (за методом кривої «потік – об'єм») внаслідок розвитку обструктивних змін бронхолегеневого апарату верхніх дихальних шляхів. Після 49 років проживання в таких умовах майже в усього населення реєструють донозологічні стани (91,7–93,9 %). При тривалому проживанні в умовах забруднення вірогідно збільшується обструкція на тлі рестрикції. Захворюваність на патології органів дихання серед дорослих вища при високому рівні використання потужностей виробництва.

**Висновки.** У 53,8 % жителів промислового міста є відхилення вентиляційної функції внаслідок розвитку переважно обструктивних змін бронхолегеневого апарату верхніх дихальних шляхів (обструкції на тлі рестрикції та обструкції).

**Ключові слова:** повітря забруднення, хвороби органів дихання, гігієнічна донозологічна діагностика.

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Залежно від віку зростає питома вага осіб із донозологічними станами функції зовнішнього дихання, найбільше – у віці 30–39 і 40–49 років. Результати свідчать, що між забрудненням атмосферного повітря та захворюваністю населення є кореляційний зв'язок високого ступеня. Так, коефіцієнт кореляції між показником сумарного забруднення повітря міста та хворобами органів дихання становить 0,72 ($p < 0,01$) у дорослих та 0,66 ($p < 0,05$) у дітей.

Захворюваність дорослого населення мегаполісу на патології органів дихання останніми роками хвилеподібно зменшувалась. Тренд її динаміки мав вигляд $y = 3343,2–47,97x$ при коефіцієнті множинної кореляції 0,78 ($p < 0,05$). Особливо значно захворюваність зменшилася в дослідній групі внаслідок зниження рівня використання потужностей виробництва. Закономірністю захворюваності дитячого населення на хвороби органів дихання є майже однакова лінія тренду як при високому, так і при помірному рівні використання потужностей виробництва – тренд динаміки мав вигляд рівняння $y = 10190,3 – 41,2x$ та $y = 8813,9–76,3x$ при коефіцієнті множинної кореляції 0,59–0,64 ($p < 0,05$).

**Ключевые слова:** воздуха загрязнения, болезни органов дыхания, гигиеническая донозологическая диагностика.

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## Влияние индустриальных атмосферных загрязнений на развитие патологии органов дыхания

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Вследствие техногенной нагрузки в первую очередь нарушается качество воздушного бассейна. Более 80 % заболеваний в той или иной степени зависят от его качества, но особую приоритетность атмосферные загрязнения имеют для патологии органов дыхания.

**Цель работы –** изучить особенности развития патологических состояний органов дыхания у населения, проживающего в условиях значительных атмосферных загрязнений.

**Материалы и методы.** Исследованы промышленные выбросы в воздушный бассейн от предприятий металлургической отрасли. По кривой «поток – объем» форсированного выдоха определяли тип нарушений вентиляционных функций (обструкция, рестрикция, обструкция на фоне рестрикции). Заболеваемость изучали по статистическим материалам больниц.

**Результаты.** На жителей промышленного города действует комплекс экотоксикантов, что приводит к опасной степени загрязнения и опасному уровню загрязнения атмосферного воздуха. У 53,8 % жителей города установлены отклонения вентиляционной функции (по методу анализа кривой «поток – объем») вследствие развития обструктивных изменений бронхолегочного аппарата верхних дыхательных путей. После 49 лет проживания в таких условиях практически у всего населения регистрируют донозологические состояния (91,7–93,9 %). При длительном проживании в условиях загрязнения достоверно возрастает обструкция на фоне рестрикции. Заболеваемость болезнями органов дыхания у взрослых выше при высоком уровне использования мощностей производства.

**Выводы.** У 53,8 % жителей промышленного города отмечены отклонения вентиляционной функции вследствие развития преимущественно обструктивных изменений бронхолегочного аппарата верхних дыхательных путей (обструкции на фоне рестрикции и обструкции). В зависимости от возраста растет удельный вес лиц с донозологическими состояниями функции внешнего дыхания, наибольший – в возрасте 30–39 и 40–49 лет. Результаты свидетельствуют, что между загрязнением атмосферного воздуха и заболеваемостью населения есть корреляционная связь высокой степени. Так, коэффициент корреляции между показателями суммарного загрязнения воздуха города и болезнями органов дыхания составляет 0,72 ($p < 0,01$) у взрослых и 0,66 ($p < 0,05$) у детей.

Заболеваемость взрослого населения мегаполиса болезнями органов дыхания в последние годы волнообразно уменьшалась. Тренд ее динамики имел вид $y = 3343,2–47,97x$ при коэффициенте множественной корреляции 0,78 ($p < 0,05$). Особенно значительно заболеваемость уменьшилась в опытной группе вследствие снижения уровня использования мощностей производства. Закономерностью динамики заболеваемости детского населения болезнями органов дыхания была практически одинакова линия тренда как при высоком, так и при умеренном уровне использования мощностей производства – тренд динамики описывается уравнениями $y = 10190,3 – 41,2x$ и $y = 8813,9–76,3x$ при коэффициенте множественной корреляции 0,59–0,64 ($p < 0,05$).

Primarily, the quality of air is violated because of anthropogenic impact. Public health is one of the leading criteria of environmental quality. Atmosphere pollution in the industrial city determines the priority of respiratory organs pathology [1]. According to World Health Organization (WHO), atmosphere pollution belongs to the priority risk factors for public health, more than 80 % of diseases depend on the air quality in varying degrees [2].

At the same time, the development of industrial production and the growth of volumes of use of chemicals against the backdrop of intensive urban urbanization are conditioned by constant qualitative and quantitative changes in the impact of industrial emissions and greatly complicate the problem of sanitary protection of the air basin. The negative impact on the health of atmospheric air pollution remains incompletely studied due to the extraordinary complexity of such studies in the city [3].

It has been determined that the safety and optimal condition of the environment and health of industrial cities largely depend on the nature and extent of the harmful emissions on the organism. The real threat to public health is aggravated by the simultaneous pollution of the environment by a large number of harmful chemicals from stationary and mobile sources [4].

At the same time, in the professional literature sources, the questions about peculiarities of the development of pathological conditions under the influence of numerical ecotoxicants, the substantiation of the criteria for the early manifestations of pathological changes, which are the precursors for the clinical forms of diseases, remain unclear.

## The purpose

The purpose of the work is to study the peculiarities of the development of pathological states of respiratory organs in the population living in conditions of significant atmospheric pollution.

## Materials and methods

The industrial emissions into the air from the metallurgical enterprises were studied during 1990–2014. The volume of emission studies for priority pollutants was 7248 analyzes. By means of electronic spiroanalyzers RID-124-D and SPIROCOM HAI-Medica are a medical screening of 377 conditionally healthy residents of Zaporizhzhia, aged from 19 to 80 years without complaints about the respiratory system and who have never been under medical supervision due to respiratory organ diseases (asthma, tuberculosis, pneumonia, bronchiectasis, cystic fibrosis, tumors, goiter, polyps, allergic rhinitis). These were the patients of the clinic, who went to medical institutions for other diseases (traumatic, gynecological, urological, otolaryngologic, gastroenterological, ophthalmologic and infectious pathology) and did not have professional contacts with the harmful factors of the production environment. At the time of the survey, all investigated residents did not have a bad habit like smoking.

Spirometric studies are performed according to international standards [5,6]. According to spirometric indicators, the presence of violations of the ventilation function was identified and their type (obstruction, restriction or obstruction against the background of restriction) was determined. The obstructive type was defined as the decrease in peak volume (volume of excited exhalation velocity), volume exhalation velocity in the range of 25–75 % of FVC and volume of forced exhalation for 1 second without corresponding reduction in lung capacity. Restrictive type of violation was characterized by a predominant decrease in the lung capacity, volume of forced exhalation for 1 second against the background of normal or increased its correlation with the forced vital capacity of the lungs. The curve of the loop has a narrower shape due to a decrease in the volume of the lungs. The mixed type criterion (obstruction against the background of restriction) was the simultaneous reduction of the volume of forced exhalation for 1 sec, lung capacity and their ratio. In this case, the volume of forced inspiration is greater than exhalation. The degree of obstruction is determined by the specific spirographic sign (volume of forced exhalation for 1 sec). For the obstruction of large and medium bronchi, a specific displacement of the point of a voluminous forced speed in the range of 50 % FVC. The obstruction of small bronchi and bronchioles is characterized by a decrease in the volume of forced velocity in the range of 75 % FVC.

For the analysis of the morbidity and prevalence of respiratory diseases, the statistical materials of the treatment and prophylactic institutions of Zaporizhzhia were used (9680 primary medical documents were processed). Hygienic, analytical-synthetic, physiological and statistical methods are used.

On the basis of the parameters of air pollution: the total pollution index (ΣTPI), the maximum allowable contamination (MAC), the multiplicity of excess of the total indicator of the maximum permissible level of pollution (ΣTPI/MAC), two groups of supervision have been formed. The control group included Dniprovskyi and Khortytskyi districts, where the value of the indicator ΣTPI/MAC was 1.9 ± 0.1; the research group – Zavodskyi, Oleksandrivskyi, Voznesenskyi and Komunarskyi (industrial) districts where the value of the indicator ΣTPI/MAC was 10.0 ± 0.2. The data is presented in the form of averages and standard mean error. The significance of differences was estimated using Student's t-criterion for independent and dependent samples at $P < 0.05$.

The correlation-regression method determined the relationship between the volume of emissions of harmful compounds in the air and the level of pollution with harmful substances of atmospheric air in the city of Zaporizhzhia. The pathological impact of air pollution contamination is established by a regression analysis of the relationship between the total level of air pollution and the incidence of diseases of the respiratory system with the subsequent justification of the regression equations. For regression analysis, the criterion indicators of industrial emissions and concentrations of harmful chemicals in the atmospheric air of the metropolis are used.

Statistical processing: the results of the performed researches were processed by the method of variation statistics using the package of the license program Statistica for Windows 13 (StatSoft Inc., № JPZ804I382130ARCN10-J).

## Results

The dominating factor that causes respiratory diseases among the population of the steel-industry city is the high level of aerogenic pollution. During last decade, the total level of air pollution exceeded 5,6 times hygiene regulations. According to existing standards, such a degree of air pollution is defined as dangerous, and the level of pollution – very dirty.

The industrial city residents are influenced by whole complex of harmful substances. The most important for air pollution among them are the emissions from petrol (341.80 tons/year), manganese dioxide (338.04 tons/year), calcium oxide (258.60 tons/year), chlorine (228.9 tons/year), ammonium (149.10 tons/year), xylol (141.80 tons/year). The maximum permissible concentration (MPC) of dust is exceeded in half of all air samples and aerosols and vapor – in more than one third. The atmospheric air of industrial city has properties of dynamic environment in qualitative and quantitative points. Particularly, fluctuations of gross emissions (94.3–222.3 tons/year), emissions of solids (9.4–50.7 tons/year) and gas (100.2–171.6 tons/year).

Among the 377 surveyed residents of Zaporizhzhia, there were 163 men and 214 women. According to the results of the spirography, 92 men and 109 women had respiratory failure *(Table 1)*. The main gender difference is the higher proportion of obstructive males (6.1 %) and obstruction against the background of restriction (10.4 %), but they were characterized by a tendency ($P < 0.1$).

While analyzing of respiratory function age dynamics in the industrial city population, an increase in the proportion of people with prenosological states was established *(Fig. 1)*.

**Table 1.** Gender characteristics of the prenosological state (%)

| Prenosological state | Men n = 92 | Women n = 109 |
|---|---|---|
| Obstruction | 44.6 | 38.5 |
| Restriction | 6.5 | 23.0 |
| Obstruction combined with a restriction | 48.9 | 38.5 |

**Table 2.** Distribution of obstruction, restriction and obstruction combined with a restriction in different age groups (n, %)

| Age, full years | Types of violations | | |
|---|---|---|---|
| | obstruction, n = 84 | restriction, n = 32 | obstruction combined with a restriction, n = 85 |
| 19–29 | 17 (53.1) | 11 (34.4) | 4 (12.5) |
| 30–39 | 8 (42.1) | 1 (31.5) | 10 (26.4) |
| 40–49 | 19 (46.3) | 5 (18.5) | 13 (35.2) |
| 50–59 | 17 (35.4) | 8 (16.7) | 23 (47.9) |
| 60–69 | 14 (35.0) | 5 (12.5) | 21 (52.5) |
| 70–80 | 9 (36.0) | 2 (8.1) | 14 (55.9) |

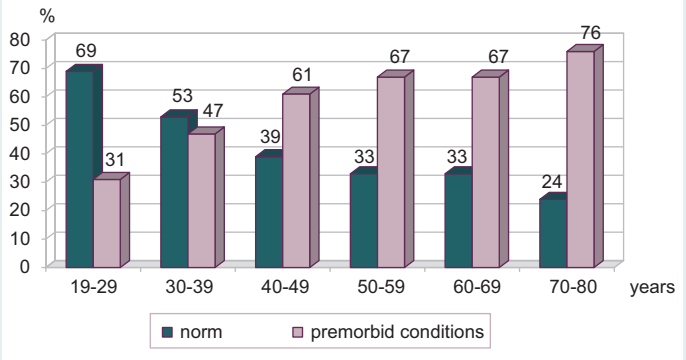


**Fig. 1.** Age dynamics of the state of respiration.

But mostly, the age-related changes had character of a tendency. A statistically significant increase was detected only at the age of 30–39 and 40–49, in which prenosological states respectively increased by 16.5 % (P < 0.05) and 13.2 % (P < 0.05).

The age dynamics of different types of respiratory function prenosological states had more diverse character *(Table 2)*. Thus, proportion of people with obstruction after relative stability at the age of 19–29 years (50.1–53.1 %) was further decreasing. Especially significant decrease was at the age of 30–39 years (by 11.0 %, P < 0.05) and 50–59 years (by 10.9 %, P < 0.05).

Because of restriction, a dynamics of prenosological states had a similar character: after relative stability at the age of 19–39 years (31.5–34.4 %), proportion of individuals decreased to 8.1 % at the age of 70–80 years. However, the feasible reduction was only at the age of 40–49 years (13.0 %, P < 0.05).

The specific features of prenosological states of respiratory organs caused by obstruction combined with a restriction had increase of their share after 29 years from 12.5 to 55.9 %. But, in general, they had character of a tendency, excluding 30–39 years (increase by 13.9 %, P < 0.05) and 50–59 years (by 12.7 %, P < 0.05). It should also be mentioned about statistical significant decrease in the number of people with this condition of prenosological state in group of 19–29 years old (by 11.9 %, P < 0.05).

The established nature of formation of the prenosological states (reduction of obstruction and the background of the restriction of stability) suggests that the formation of more complex pathology is due to the "injection" of persons with obstruction in it. This is probably indicative of the low effectiveness of their treatment.

A high degree correlation exists between air pollution and population morbidity. Thus, the correlation coefficient between the total city air pollution indexes and respiratory diseases is 0.72 (P < 0.01) in adults and 0.66 (P < 0.05) in children.

The regularities of long-term chromodynamics of respiratory organs incidence among children is almost the same as at high and at a moderate level of industrial production – dynamics tendency has a look of equation y = 10190.3 – 41.2x and y = 8813.9 – 76.3x with a coefficient of multiple correlation 0.59–0.64 (P < 0.05).

The results of study found that incidence of respiratory organ diseases among adults with moderate level of industrial production significantly decreased by 1.8 times (P < 0.01) and was 1558.4 ± 24.1 cases / 10 thousand, compared to 2773.2 ± 154/2 cases / 10 thousand at high level of industrial production. On an average, incidence of respiratory diseases among residents of Zaporizhzhia city declined by 4 % annually. After decrease in power production level of use, the incidence on ARVI among adults significantly decreased by 1.5 times (P < 0.01), mean value of which at moderate level of IP was 1031.3 ± 28.1 cases against 1577.0 ± 73.3 cases / 10 thousand at high level of IP. Thus, on the background of reduced air pollution at a moderate level of IP the incidence of ARVI in adults significantly decreased, the percentage of which was 43.3 % to 47.3 % at high level of IP. The incidence of industrial city adults on such diseases as chronic laryngitis and laryngotracheitis, chronic pharyngitis, bronchitis and chronic pneumonia at moderate level did not change significantly. At the same time, among adult city inhabitants incidence of asthma increased by 2.9 times (P < 0.001) with a mean value of 3.8 ± 0.3 cases/10 thousand to 1.3 ± 0.1 cases/10 thousand at a high level of IP.

At moderate level of IP, the incidence on respiratory organs diseases among children significantly increased by 1.1 times (P < 0.05). Its level was 11121.8 ± 149.2 cases 0/10 thousand at moderate level of IP against 9947.9 ± 126.5 cases/10 thousand at high level of IP. At moderate level of IP, indexes of morbidity on ARVI increased by 1.3 times (P < 0.01), and were 8984.1 ± 193.3 cases/10 thousand against 7340.1 ± 344.1 cases /10 thousand at high level of IP. The proportion of ARVI increased significantly from 52.8 % to 56.7 %. In this period, the incidence of tonsils chronic diseases among children population increased significantly by more than 2.2 times (P < 0.001), with average values of 117.6 ± 9.4 cases/10 thousand against 53.9 ± 6.7 cases/10 thousand (P < 0.05).

## Discussion

The spirography with analysis of the curve "flow – volume" is referred to the priority methods of early diagnosis of

broncho-obstructive changes [5,7–9]. Electronic spirometry is widely used as a screening tool for early diagnosis of COPD [10]. The identification of deviation types from the normal functioning of respiratory organs, that are influenced by atmospheric pollution, makes it possible to obtain necessary understanding of the nature, strength, determination of their effect on vital signs of the body, on the one hand and on the other – to determine the possibility of the number of factors eliminating, reducing the force of impact. This also allows to justify, optimize and implement rational methods of medical and physiological rehabilitation and treatment-prophylaxis measures of the prevention of environmental factors harmful effects on the body.

Thus, the basis of establishment of the pre-nosological states of respiratory organs are specific pathophysiological mechanisms of influence of aerogenic contaminations on the body. In particular, obstructive deviations are caused by reflex spasm of the smooth muscles of the trachea and bronchi or by the swelling of the airway walls as well as various inflammatory reactions [7]. The determinants of this action are harmful chemicals, dust particles that are in the air of the working zone. Aggravation of the phenotypes of professional COPD is selectively associated with the action of chemicals and dust [11]. The determinants of this action are harmful chemicals, dust particles that are in the air. In patients with bronchial asthma, compared with healthy, resistance of small bronchuses is 7 times higher than with normal parameters of pulmonary function [12]. In the industrial metropolis, the prevalence of restriction is much higher than in occupational risk groups. Thus, in the railway industry workers with occupational hazards in the form of dust pollutants, the restriction was detected only in 6.1 % [13]. Other researchers also noted the difference in spirographic parameters and the severity of general symptoms in patients with occupational risk [7].

The prevalence of restriction and its relative stability indicate a significant resistance to pulmonary volume in an industrial city. Perhaps this is due to the greater stability of the inspiratory and expiratory respiratory muscles to ecotoxicants, as well as due to the stability of the elastic traction of the lungs. Significant prevalence of bronchoobstructive disorders is due to structural remodeling of the bronchopulmonary tree. Along with this factor for obstruction of bronchi and chemical disfiguring the COPD phenotypes is the increase of viscous respiratory oppression due to hypersecretion of mucus and changes in bronchoconstriction and chronic inflammation [7].

The analysis of professional literature has shown that scientists from different countries have determined the correlation dependence indicators of morbidity of the population on diseases of respiratory organs from specific pollutants [2,4,14]. In particular, direct strong connections were found between the incidence rates of children and adults in respiratory diseases ($r = 0.7$, $P < 0.05$ in children and $r = 0.6$, $P < 0.05$ in adults) and concentrations of suspended substances, sulfur and nitrogen oxides, while the very weighed substances possess properties related to the accumulation of toxic gaseous compounds with the formation of pyrogenous compositions whose biological effects are characterized by increased toxicity and activation of the formation of immunopathological processes, a decrease in the level of antioxidant protection, etc.

Other studies also indicate a significant relationship between contamination and diseases. In particular, the direct correlation coefficient $r = 0.6$ ($P < 0.05$) is established between the frequency of acute upper respiratory infections in younger schoolchildren who have long lived in the areas of the metallurgical industry and the level of air pollution [14]. In the industrialized city, the incidence of diseases of the upper respiratory tract in children who lived in the contaminated area was 1,8 times more likely and 1.4 times – to other respiratory diseases. The correlation coefficient between the level of atmospheric air pollution and the disease was $r = 0.81$ ($P < 0.01$), in the second – $r = 0.78$ ($P < 0.01$) [14].

A direct correlation between the incidence of acute respiratory infections (ARI) and atmospheric air pollution by dust, carbon monoxide, fluorides and fluoride hydrogen was established. This gave rise to the conclusion about the significant contribution of the above-mentioned chemical contamination to the formation of respiratory system diseases in the level of 41.8 % among all officially registered ARI.

In chronic obstructive pulmonary diseases, comorbidity is more common. In particular, the concomitant diseases are often recorded: arterial hypertension, depression and anxiety, ischemic heart disease, and osteoporosis [8,15]. At the same time, the prevalence of comorbid diseases increased with the severity of COPD.

Consequently, the results and materials of other researchers obtained by us to testify the advantage of using electronic spirometry in order to diagnose early pathological conditions while simultaneously analyzing the incidence [5,7,16].

Therefore, a key element in the prevention of adverse effects of atmospheric pollution on the body is hygiene prenosological diagnostics, which means assess of the body states that precede nosological forms or their risk factors.

## Conclusions

1. According to spirographic survey by method of curve “flow – volume” analysis, 53.8 % of inhabitants of industrial cities have deviations in ventilation function due to progress of obstructive changes in bronchopulmonary apparatus of upper respiratory tract (obstruction combined with a restriction and obstruction). With age, the proportion of people with prenosological states of respiratory function increases, especially among those 30–39 and 40–49 age groups. The dynamics of different types of prenosology states of respiratory function had age-related features: after relative stability at the age of 19–29 years, the proportion of people with obstruction further decreased, especially at the age of 30–39 years.

2. A high degree correlation exists between air pollution and population morbidity. Thus, the correlation coefficient between the total city air pollution indexes and respiratory diseases is 0.72 ($P < 0.01$) in adults and 0.66 ($P < 0.05$) in children.

3. The incidence on respiratory diseases among metropolis adult population was wavelike decreasing. The tendency of its dynamics looked like y = 3343.2–47.97x, with a coefficient of multiple correlation 0.78 (P < 0.05). Among children dynamics tendency has a look of equation y = 10190.3–41,2x and y = 8813.9–76,3x with a coefficient of multiple correlation 0.59–0.64 (P < 0.05). Especially, the incidence decreased significantly in the experimental group due to the decrease of power production level. The pattern of the dynamics of the incidence on respiratory diseases among children is almost the same trend line at high and at a moderate power production levels. The incidence on respiratory diseases among adults is significantly higher at high level of production both in group of study and control group. Among adults of ecologically polluted areas the prevalence of respiratory diseases is significantly higher both at high and moderate level of production. Among children, prevalence of respiratory diseases is significantly higher in ecologically unfavorable areas.

**Prospects of further research** are the establishment of prognostically significant risk factors for respiratory organs of industrial cities at the prenosological level and the substantiation of preventive measures to reduce the harmful effects of atmospheric pollution.

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