Geo-ecological assessment of job-related diseases in mono-cities of the Russian Federation

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Abstract. The relevance of the study is due to the importance of the health state and the quality of life among the population in connection with the adverse influence of a number of factors (environment, emission from large enterprises, food quality, and natural resources). In the list of these factors affecting the health of employees working in industrial enterprises, harmful factors of the working environment are very important, the impact of which under certain conditions leads to high morbidity with temporary disability, to the development of work-related diseases. The results of a study investigating the level of work-related morbidity suggest that the number of employees in hazardous and harmful working conditions at industrial enterprises in Magnitogorsk increased to 42.95%. In 2017, the ratio of workplaces of industrial enterprises that do not meet sanitary and hygienic requirements for noise increased; the same variable (ratio) according to the standards of vibration, microclimate, lighting decreased; no deviations were detected in electromagnetic fields (EMF). Chronic work-related pathology in 2017 more often arose due to imperfection of technological processes (36.65% of cases), imperfection of workplaces (30.0%), structural shortcomings of labor facilities (16.65%) and sanitary facilities (6.65%), labour (working) contact with an infectious agent (10.0%). The results of the study can be used to improve programs at the federal and regional levels to improve the environmental situation.

1. Introduction
Preserving the health of employees is a priority of state policy in the field of labor relations, labor protection that means that an employer has to provide healthy and safe working conditions targeted at prevention of work-related diseases since the economic recovery of the country in general is associated with the able-bodied (employable) population. Of the list of industrial factors, working conditions of employees are the main risk factor in development of job-determined pathology. Assessing the level of harmful effects impacted on employees in the course of their labor activity, identifying certain factors of a labor process and the development of mechanisms to control them with the aim to reduce the levels of acceptable risks allow preserving the health of employees and lead to saving labor resources as well.

The aim of the paper is to give a geo-ecological assessment of the level of job-related morbidity in mono-industry towns of the Russian Federation based on the example of Magnitogorsk; to propose some measures ensuring healthy working conditions.
2. Materials and methods

Occupational morbidity is the frequency of cases of all job-related diseases (poisoning) recorded during the year among the working population, or groups that underwent a medical examination [1].

Issues of occupational morbidity among the population are widely covered both in Russian literature and in foreign one.

Theoretical and methodological issues of the sanitary-epidemiological well-being of the population are considered in the works of Ivanov S I, Belyaev E N [2], Butaev T M, Reshetnikov A V, Kuchereno V Z [3], Kuzmin V B [4], Zaitseva N V [5], Steblyanko V L [6], Zinovieva E [7; 8; 9] and others.

Theoretical and methodological issues regarding the quality of atmospheric air, soil and water, the level of occupational morbidity, emissions of pollutants are considered in the works of Butorina N N [10], Onishchenko G G [11], Mayorova T V [12; 13] etc.

Possibilities of using foreign experience in the sanitary-epidemiological well-being of the population in the Russian Federation are being studied by such authors as Smolensky V Yu [14], Toporkov I G, Leaves G D [15], Herbert R D, Jaakkola J J K [16], Alvarez-Herranz A [17], Aznar-Sánchez J A [18], Jiang K [19], Fu Y [20], Gani A [21], Pacca L [22] etc.

The theoretical base for the study in the view of the effective indicators is provided by the documents of legislative authorities, regulatory legal acts of the Federal Service for Supervision of Consumer Rights Protection and Human Well-being of the Russian Federation [23; 24], as well as the data from the Office of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being in the Chelyabinsk Region, Magnitogorsk city for 2014 - 2016 [25].

3. Assessment of occupational morbidity level in Magnitogorsk city

It is customary to study the geo-ecological basis for monitoring public health in the following areas: the state of the human environment and its impact on public health; the state of the medical and demographic situation and the incidence of mass non-communicable diseases (poisoning) in connection with the harmful effects of environmental factors on humans; level of occupational morbidity. In this article, we analyze the level of the occupational morbidity.

![Figure 1. Ratio of workplaces at the industrial enterprises within the physical factors, %](image-url)

The level of the occupational morbidity in Magnitogorsk is significantly impacted by some working conditions, as one of the main risk factors for development of a professionally determined pathology. At the industrial enterprises of Magnitogorsk (controlled by the territorial department) the number of workers employed in jobs with harmful and dangerous working conditions has increased...
and amounts to 42.95%. Over the past 3 years, there has been no tendency to a decrease in the ratio of employees who work in harmful and dangerous conditions, and there has even been a slight increase in this indicator, for example, in 2015 - 42.6%, in 2016 - 42.8%, in 2017 - 42.95%. The condition of the workplaces at the industrial enterprises in terms of certain physical factors in 2017 changed compared to 2016. So, in 2017, the ratio of jobs at the industrial enterprises, which do not meet the sanitary and hygienic requirements, increased concerning such a physical factor as noise, the ratio of jobs, which do not meet the sanitary and hygienic standards for vibration and microclimate, and lighting, decreased. Graphically it is represented in Figure 1.

The highest occupational morbidity rate per 10 thousand employees was recorded, as in previous years, at manufacturing enterprises - 3.93. The data are shown in table 1.

**Table 1.** Indicators of the occupational morbidity by the main types of economic activity

| Types of economic activity                      | Indicator per 10,000 employees |
|------------------------------------------------|-------------------------------|
|                                                | 2015  | 2016  | 2017  |
| For all types of economic activity             | 1.72  | 1.81  | 3.19  |
| Manufacturing enterprises:                     | 2.54  | 2.12  | 3.93  |
| Production of other non metallic mineral products | 4.31  | -     | -     |
| Metallurgical production                       | 2.71  | 3.11  | 6.60  |
| Manufacture of fabricated metal products       | -     | 4.54  | 1.13  |
| Machinery and equipment production             | 1.64  | 0.55  | 2.91  |
| Recycling of secondary raw materials           | 11.16 | 11.16 | -     |
| Civil building                                 | 1.99  | 1.33  | 2.24  |
| Health care and social services                | -     | 1.37  | 4.11  |

Chronic job-related pathology in 2017 more often arose due to imperfection of technological processes (36.65% of cases), imperfection of workplaces (30.0%), structural shortcomings of labor facilities (16.65%) and sanitary facilities (6.65%), labour (working) contact with an infectious agent (10.0%). All this information is presented in Figure 2.

**Figure 2.** Circumstances and conditions caused chronic occupational diseases, %

The level of chronic occupational pathology detection, depending on the type of medical institutions and their specialization, practically has not changed. In 2017, Magnitogorsk Center for Occupational Pathology detected 96.67% of cases of occupational diseases (in 2016 - 95.24% of the
total number of cases, in 2015 - 86.67%). The analysis showing the dependence between the level of occupational morbidity on a job, duration of contact with a harmful production factor and the age of an employee allows us to identify individual occupational groups that are most at risk of any occupational pathology.

The analysis of occupational pathology, first established in 2017, allows us to conclude that the length of job experience, exposure to a harmful occupational factor and the level of occupational morbidity are interconnected, and the maximum risk of an occupational disease at industrial enterprises is manifested among male workers exposed to harmful occupational factors over 30 years, whereas, among female workers this job experience is over 20 years. In the 20-30-year experience, the share of registered occupational diseases among male workers is 31.82%, with the experience of 30-40 years - 63.64%, whereas the figure among female workers in the group with 20-25-year experience is 66.7% of all occupational diseases distributed by a gender principle.

Workers aged at 50-60 are most at risk of occupational disease: occupational diseases among men at this age category are 90.91%, among women - 66.67% of all occupational diseases distributed by gender. Depending on the professions of workers, men and women are at greatest risk of acquiring occupational pathology - electric gas and gas welders, refractory workers, coke oven drivers, choppers. The share of occupational diseases of workers in these professions first documented in 2015–2017 is 36.21%.

Most cases of occupational pathology were detected during periodic medical examinations and all were of chronic forms, which, as a rule, were gained by workers with large job experience (more than 30 years) in contact with a harmful production factor and at the age over 50. Despite a decrease in the indicator of the validation of victims, the severity of the course of an occupational disease and the degree of losing professional suitability, it remains higher than the all-Russian one and is an indicator of low active detectability of occupational pathology under the current system of medical examination of mandatory groups of employees.

As of the end of 2017, in the Office of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being in the Chelyabinsk Region in Magnitogorsk, there were under control 175 industrial enterprises with a total number of 87,181 employees, including 37,452 people working in harmful conditions, which is shown in table 2.

Table 2. Number of industrial enterprises and number of employees working in Magnitogorsk within 2015-2017

| Year | The number of employees in total, people | Including those who work in harmful and adverse working conditions, in person | Ratio of workers working in harmful and adverse working conditions, % |
|------|------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------|
|      | total | deviation, % | 37133                                                                 | 42.6                                                                  |
| 2015 | 87080 | -5.4          | 37133                                                                 | 42.6                                                                  |
| 2016 | 86905 | -0.2          | 37153                                                                 | 42.75                                                                 |
| 2017 | 87181 | +0.32         | 37452                                                                 | 42.96                                                                 |

The main number of employees - 76788 people or 88.0% is concentrated at the enterprises of six types of economic activity: metallurgical production - 25759 people; mechanical engineering - 20637 people; civil building - 13426 people; manufacture of fabricated metal products - 8871 people; land transport activities - 5687 people; production of building materials - 2408 people. At the enterprises where the main number of employees is occupied - MMK JSC, MRK JSC, Ogneupor LLC, OSK LLC, MMK-METIZ JSC, as before, working conditions do not comply with the hygienic standards. Accordingly, the technological processes that cause non-compliance of working conditions with the sanitary norms and rules are as follows: coke production, iron and steel smelting, foundry, metal cutting - according to the presence of harmful substances in the air of the working area; metal processing, production of hardware and wire, chipping operations, - on production noise; vibration
pressing in the manufacture of building materials, polishing, forging, hand molding - according to the level of general and local vibration.

The harmful effects of production factors are exacerbated by the lack of regulated breaks and working hours for employees at enterprises when they work in cooling or heating microclimate, as well as they work with vibration tools in conditions of high levels of noise connected with industrial and production processes.

4. Conclusion

Thus, in the field of ensuring healthy working conditions, it is advisable to propose actions to be fulfilled:

- to consider the development of a targeted program "Improving working conditions and medical support for the working population of Magnitogorsk city";
- to organize production monitoring of compliance with the sanitary rules, hygiene standards and some preventive measures;
- organize periodic medical examinations of those who are working in contact with harmful production factors;
- to carry out all planned actions to improve working conditions at the workplaces of industrial enterprises, as well as to develop some additional measures helping to bring working conditions at workplaces to the requirements of the hygienic standards (increase the efficiency of ventilation systems, replace technically obsolete equipment, upgrade technological equipment, repair technology for metallurgical furnaces and aggregates). For this reason, the primary task of any municipality is to monitor the environmental situation, provide labor protection, and medical examinations (periodic).

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