ISSN 2223-6775, Ukrainian Journal of Occupational Health, 2021, 17 (3), 204–210

UDC 613.6:622.012 (477) https://doi.org/10.33573/ujoh2021.204

ANALYSIS OF EMPLOYMENT OF EMPLOYEES OF MINING ENTERPRISES IN HARMFUL WORKING CONDITIONS

Pavlenko O. I.

State Institution «Ukrainian Scientific Research Institute of Industrial Medicine», Kryvyi Rih

Introduction. An essential prerequisite of the development and implementation of preventive measures aimed at improving the health of workers by increasing their productivity is to establish an objective link between the morbidity of workers and working conditions, which is based on understanding the causes of morbidity and the principles of the evidence base.

The purpose of the research is to conduct an in-depth analysis of the employment of workers in the mining industry in harmful working conditions.

Materials and methods of research. The analysis of employment of workers in harmful working conditions was carried out according to 10 final acts of periodic medical examinations of 9023 employees of the mining industry of Kryvyi Rih (2014–2019). During the research, conservation measures were taken to maintain medical secrecy about patients.

Results. The number of employees exposed to harmful and dangerous factors of the production environment and labor process varies at the mining industry from 3465.00 (2018) to 4020.00 (2014) with a tendency to decrease. In 2018, the number of people under the age of 21 working in harmful working conditions increased to 4,24 per 100 employees, compared to 3,83 per 100 employees (2015) and 3,06 per 100 employees (2014). The number of working seniors has almost decreased threefold, from 9,21 per 100 employees in 2015 to 2,77 per 100 employees in 2018. The number of people with more than 10 years of work experience in harmful working conditions is consistently high and ranges from 62.66 % (2014) to 53.19 % (2018). The number of women with more than 10 years of work experience is 53.0 % (2018). The leading harmful production factor that occurs in the workplace of employees of the mining industry (according to the final act on the results of medical examinations) is the severity of work – 80,20 % (women 65,10 %) from the registered number of regular employees working in harmful conditions.

Conclusions. The dynamics of the number of workers employed in harmful and dangerous working conditions is associated with changes in working conditions, technological process, with a decrease in the total number of employees due to the optimization of production and labor migration. Work experience of more than half of the average period of development of occupational diseases in the profession is a risk factor, and the work in harmful conditions for persons over 40 is critical, which requires the development and implementation of measures to assess and manage occupational risk.

Key words: working conditions, harmful production factors, occupational morbidity, assessment and management of occupational risk, periodic medical examinations

ISSN 2223-6775, Ukrainian Journal of Occupational Health, 2021, 17 (3), 204–210

Introduction

An indispensable condition for the development and implementation of preventive measures aimed at improving workers' health with increasing their productivity is the establishment of objective connection of workers' morbidity with working conditions, based on the understanding of the causes forming morbidity and on the principles of evidence about the influence on morbidity not only of biological, family, household, medical and preventive factors, but also of the industrial and occupational ones [1–3]. The frequency of cases of temporary disability for diseases is of paramount importance, which is due to the fact that the change in the frequency of cases is the evidence of the impact of working conditions on workers' health [4, 5].

Long-term exposure to occupational factors changes the level and structure of certain nosological forms of diseases among workers, complications of general somatic diseases are observed [6, 7].

Despite the great number of scientific research conducted and the development and implementation of modern justified measures to assess and manage occupational risks, still there can be found the economic loss associated with the loss of labor potential, compensation for disability, medical costs for treatment and rehabilitation of patients, as well as the reproduction of the workforce, which makes the problem of prevention and early diagnosis of occupational pathology one of the priorities in the field of occupational medicine, both in Ukraine and around the world. The economic losses of Ukraine regarding the provision of social payments to citizens as a result of occupational diseases and industrial injuries reach billions of hryvnias annually [8–10].

Thus, the state of working conditions is a determining factor in formation of level and structure of occupational pathology, which requires the development and implementation of scientifically valid measures aimed at managing occupational risk.

The purpose of the study is to carry out an in-depth analysis of the employment of workers of extractive industry enterprises in hazardous working conditions.

Materials and methods of research

The object of the study is sanitary and hygienic state of working conditions and morbidity according to the results of periodic medical examinations of employees of enterprises in the extractive industry.

Analysis of employment of people working in hazardous conditions in the extractive industry enterprise, while taking into account seniority, age and gender and primary diagnosis of common diseases, was studied in the analysis of the final acts of periodic medical examinations of 2014–2019. The total of 10 final acts based on the results of periodic medical examinations of 9023 employees of the extractive industry enterprise in Kryvyi Rih were analyzed.

The formation of groups of employees to undergo periodic medical examinations took place in accordance with the requirements of the order of the Ministry of Health of Ukraine dated May 21, 2007 N 246 «On Approval of the Procedure of medical examinations of employees of certain categories» by analyzing the hygienic research of working conditions of employees of mining industry enterprises and including each particular employee in the list for medical examination according to the harmful factors at their workplace.

The results of the research were processed using a standard Microsoft Office Excel 2003 software package (No. NC9TK-GB4KD-3936D-8R6C8-DJTND) and STATISTICA 6.0. (№ 31415-9265-35897). The results of the studies were reviewed by the bioethics committee

ISSN 2223-6775, Ukrainian Journal of Occupational Health, 2021, 17 (3), 204–210

(protocol no. 2 of February, 24 2020). Measures were taken to maintain medical confidentiality of the patients during the studies.

Results of research and discussion

According to the analysis, it was found that the number of workers who are exposed to harmful and hazardous factors of working environment and work process may vary in the analyzed extractive industry enterprise from 3465.00 (2018) to 4020.00 (2014) with a decreasing trend, which may be due to two reasons. The first one is the changes in working conditions and the second one is the decrease in total number of employees, including those in hazardous working conditions in the enterprise due to production optimisation and labour migration.

In 2018, the number of persons under the age of 21 exposured to harmful factors of the working environment and work process increased to 4.24 per 100 workers, compared to 3.83 per 100 workers (2015) and 3.06 per 100 workers (2014), which requires more attention and dynamic monitoring not only of the health status but also of the working conditions of such persons in order to diagnose and prevent diseases that may arise from exposure to harmful production factors early on.

The number of persons of retirement age working has almost tripled, from 9.21 per 100 workers in 2015 to 2.77 per 100 workers in 2018, which indicates positive management in human resources of the company. This is so because for working in hazardous conditions the age of 40 is critical in the deterioration of health under the influence of harmful factors of production, which requires special attention from occupational safety and health specialists, the administration of the enterprise and, possibly, rational employment.

Length of service of more than half the average duration of development of occupational diseases in the profession should be considered as a significant risk factor. Such an analysis and assessment determine possible duration of contact at work under hazardous conditions, which is safe for health, as well as the timeframe for its review. Thus, 10 or more years of work experience in hazardous working conditions significantly increases the risk of developing an occupational disease. Thus, the number of individuals with more than 10 years of experience working in hazardous working conditions is consistently high, ranging from 62.66 % (2014) to 53.19 % (2018). The number of women with more than 10 years of work experience is 53.0 % (2018).

The leading harmful production factor that takes place at the workplace of employees of the analyzed extractive industry enterprise (according to the final act of the results of medical examinations) is heavy work – 80.20 % (women 65.10 %) of the registered number of staff employed in harmful working conditions. The second place is occupied by unfavorable microclimate – 75.35 per cent (58.67 per cent of women). The third place is occupied by the concentration of dust with a predominantly fibrogenic effect – 61.88 % (32.12 % of women). The fourth place is occupied by equivalent noise levels at 47.10 % (27.52 % of women). The fifth place is shared by harmful chemical substances 35.58 % (14.56 % of women) and the equivalent general vibration level 34.84 % (1.61 % of women).

The main workshops where, according to sanitary and hygienic studies, working conditions remain harmful even today, which contributes to the deterioration of health and the development of general and occupational pathologies, are the crushing plant, the recycling plant, the quarry and the technological road transport workshop.

ISSN 2223-6775, Ukrainian Journal of Occupational Health, 2021, 17 (3), 204–210

According to the analysis, it has been established that the number of employees exposed to harmful and hazardous factors of the working environment and work process at the crushing plant of the extractive industry enterprise has been quite stable over the years analyzed – from 6.71 per 100 employees (2016) to 6.31 per 100 employees (2019).

There is a negative trend of increase in the proportion of women exposed to harmful and hazardous factors of the working environment and work process from 3.31 per 100 workers (2016) to 6.96 per 100 workers (2019).

There are no persons under 21 years of age experiencing harmful effects of occupational factors in 2019, which is a positive sign. But, this indicator in 2017 was 1.68 per 100 workers and the number of women was 3.88 per 100 workers, which is quite high and has a negative impact on the occupational medicine management system.

The proportion of people of retirement age who work in hazardous conditions at the crushing plant has tended to decrease over the years, both in the total number of employees and women from 2.55 per 100 employees (including women 13.56 per 100 employees) (2016) to 0.31 per 100 employees (including women 0.35 per 100 employees) (2019).

The highest number of persons with more than 10 years of work experience was recorded in 2017 (54.90 per 100 employees). The highest number of women with more than 10 years of work experience was in 2016 (84.75 per 100 employees). But, as of 2019, the number of persons with more than 10 years of work experiencewas 24.45 per 100 employees (including women 17.95 per 100 employees), indicating a positive trend in the company's performance.

The portion of individuals working in conditions of influence of dust with predominantly fibrogenic action which exceeds admissible concentration is stably high throughout the analyzed period and reaches almost 100 % (both on the whole workshop and among women), that is connected with features of working conditions at crushing factory and formation of high concentrations of dust with predominantly fibrogenic action during technological process. A similar situation occurs when working under the influence of noise and physically demanding work conditions.

Due to the fact that the crusher process equipment generates vibration, there is a proportion of persons working under the influence of general (local) vibration, which ranges from 5.04 to 11.33 per 100 employees. The highest number of female workers exposed to general vibration occurred in 2017 (16.50 per 100 workers).

The number of employees working in unfavourable microclimate conditions decreased by a factor of 2.5 in 2019 compared to 2017.

The total number of employees who work in adverse working conditions at the ore processing plant of the mining company ranges from 402 (2019) to 495 (2016), which has a decreasing trend. At the same time, there is a negative trend of increase in the percentage of women working in hazardous working conditions from 30.91 (2016) to 42.54 per 100 employees (2019).

The percentage of persons under 21 years of age increased 8.3 times in 2019 compared to 2017 to 1.99 per (2019) compared to 0.24 per 100 workers in (2017). The situation is the same for the number of women under 21 years of age, which has increased by 5.4 times in 2019 compared to 2017.

There is a significant increase in the number of pension age workers working in hazardous conditions from 0.20 (2016) (of which women 0.65 per 100 workers) to 12.19 per 100 workers (2019) (of which women 15.79 per 100 workers). This may have a negative impact on the levels of occupational disease among the employees of the analysed enterprise.

The number of persons with more than 10 years of work experience in 2019 was 16.48 per

ISSN 2223-6775, Ukrainian Journal of Occupational Health, 2021, 17 (3), 204–210

100 employees, 2.8 times less than in 2017. Also in 2019, the number of women with more than 10 years of work experience decreased by 3.3 times compared to 2017 from 61.44 to 18.71 per 100 employees.

Taking into account the peculiarities of the technological process of the ore-dressing plant and the mechanism of dust formation and dust spreading of predominantly fibrogenic action during the years, the analyzed circa 100 % of workers of the OBF are negatively affected by dust (including women 87.72 per 100 workers in 2019), which requires development and implementation of modern measures aimed to reduce dust formation at the source and its spread in the shop floor. The similar situation occurs with the number of employees under conditions of noise levels and heavy physical labor exceeding the TLV. The number of employees working in an unfavourable microclimate in 2019 is 1.5 times lower than in 2017.

When analysing the seniority and gender structure of employees working in hazardous working conditions in the technological truck shop of a mining enterprise, we found a small number of women in the shop and a rather small number of persons under 21 years of age and persons of retirement age. There are no women under the age of 21 or of pensionable age in the workshop. Although, the proportion of persons with more than 10 years of work experience is quite high – 49.15 (2016) and 39.77 per 100 workers (2017), and the number of women with more than 10 years of work experience reaches 61.70 per 100 workers.

The leading harmful production factors that take place in the process motor transport workshop are dust of predominantly fibrogenic effect, unfavourable microclimate, which is caused by working conditions, namely the stay of the employee more than 80 % of the working time in the territory of the open pit or dumps.

A specific feature of working conditions in the workshop is the work associated with the operation of process vehicles, which generates general vibration exceeding the permissible standards. Thus, in 2016, 62.16 per 100 workers were exposed to general vibration and in 2017 it was 46.40 per 100 workers, of which 34.04 per 100 workers were women.

The next harmful production factor is equivalent noise level the impact of which in 2016 was 25.75 per 100 workers (of which women 73.08) and in 2017 was 20.87 per 100 workers (of which women 38.30).

When analyzing the working conditions of quarry workers of a mining enterprise, it was found that the proportion of persons with more than 10 years of work experience was 73.84 per 100 workers (2017), which was 1.1 times higher than in 2016. At the same time, the proportion of women with more than 10 years of work experience decreased by 1.4 times in 2017 compared to 2016, which has a positive trend.

In the structure of harmful production factors, dust of predominantly fibrogenic effect ranks first, followed by unfavourable microclimate and heavy workload in 2017. The next ranks are occupied by equivalent noise and vibration levels. Under conditions of vibration exposure during 2016–2017. A relatively low number of quarry workers are employed.

The duration of work in harmful working conditions has a proven correlation with the development of initial manifestations of general somatic pathology, with an appropriate length of work experience with a high probability of being able to transform into occupational pathology.

Conclusions

1. Working conditions of employees at the extractive industry enterprise today are characterized as harmful and dangerous.

ISSN 2223-6775, Ukrainian Journal of Occupational Health, 2021, 17 (3), 204–210

2. The dynamics of the number of workers working in harmful and hazardous working conditions may be connected with the changes in working conditions, technological process and reducing the total number of employees, including harmful working conditions at the enterprise at the expense of optimization of production and labor migration.
3. The length of service of more than a half of an average term of development of occupational diseases in the profession should be considered as a significant risk factor, and work in harmful conditions for persons aged over 40 years should be considered as critical by age with possible deterioration of health under the influence of harmful factors of production, which requires special attention of experts in labor protection and medicine, company administration, and, possibly, rational employment.
4. This situation requires from the enterprise's administration to develop and implement not only regular measures to improve working conditions, but also to carry out an in-depth medical examination and, if necessary, refer to a medical expert commission of the research institution of hygienic profile.

Prospects for further research. The received data is a source for organization and realization of periodic medical inspections with the purpose of development and introduction of effective mechanisms on revealing and accounting of the first signs of health deterioration connected with influence of working conditions, is a precondition for substantiation of a complex of actions on an estimation and management of occupational risk at work.

References

1. Nagorna A. M., Sokolova M. P., Kononova I. G. (2018), «Epidemiological studies of occupational health in Ukraine», *Ukrainian Journal of Occupational Health,* 4 (57), 3–20. https://doi.org/10.33573/ujoh2018.04.003.

2. Nagorna A. M. (2016), «Labor potential in Ukraine: medical, social and demographic characteristics (review of literature and own research)», *Journal of the National Academy of Medical Sciences of Ukraine*, 1, 70–80.

3. Sanne E.Verra, Amel Benzerga, Boshen Jiao, Kai Ruggeri. (2019), «Health Promotion at Work: A Comparison of Policy and Practice Across Europe», *Safety and Health at work*, 10 (1), 21–29. https://doi.org/10.1016/j.shaw.2018.07.003.

4. Bukhtiyarov I. V., Golovkova N. P., Helkovsky-Sergeev N. A. (2017), «Problems of preservation of health of workers of the coal industry: new challenges and new decisions». *Occupational medicine and industrial ecology,* 12, 1–6.

5. Lavicoli S., Valenti A., Gagliardi D., Rantanen J. (2018), «Ethics and Occupational Health in the Contemporary World of Work», *Int J Environ Res Public Health,* 15 (8), 26–54. https://doi.org/10.3390/ijerph15081713.

6. Bukhtiyarov I. V. et alc. (2017), «Working conditions as a risk factor for increased mortality in working pay», *Occupational medicine and industrial ecology*, 8, 43–49.

7. Preobrazhenskaya E. A., Sukhova A. V., Zorkina L. A. (2016), «Hygienic assessment of working conditions and health status of workers of mining and processing plants», *Hygiene and sanitation,* 95 (11), 1065–1070. https://doi.org/10.18821/0016-9900-2016-95-11-1065-1070.

8. Izmerov N. F., Piktushanskaya T. E. (2016), «Mortality rates of patients with occupational diseases and assessment of the quality of medical care», *Occupational medicine and industrial ecology*, 9, 18–23.

9. Nagorna A. M. (2018), «Medico-social and economic determinants of labor potential formation in Ukraine», *Ukrainian Journal of Occupational Medicine,* 2 (55), 3–19. https://doi.org/10.33573/ujoh2018.02.003.

10. Graham M., Hjorth I., Lehdonvirta V. (2017), «Digital labour and development: Impacts of global digital labour platforms and the gig economy on worker livelihoods», *European Review of Labour and Research*, 23 (2), 135–162. https://doi.org/10.1177/ 1024258916687250.

ISSN 2223-6775, Ukrainian Journal of Occupational Health, 2021, 17 (3), 204–210

ORCID ID of the author:
Pavlenko O. I. (ORCID ID 0000-0002-5784-3522).

Information on sources of funding for the study: the research has been carried out as part of the theme «Scientific substantiation and development of a system of measures to assess risks to the health and life of the working population in an environmentally hazardous region», No. of state registration 0121U109139.

Received: July 29, 2021
Accepted for publication: September 3, 2021

Contact Person: Pavlenko Oleksandr Ivanovych, leading researcher, candidate of medical sciences, Senior researcher, laboratory of sanitary-hygienic and physiological-ergonomic studies, State Institution «Ukrainian Scientific Institute of Industrial Medicine», 40, Vynogradova str., Krivyi Rih, Dnipropetrovsk region, 50096. Tel.: + 38 0 97792 53 15. E-mail: prom.aeroz@gmail.com