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Research article

ANALYTICAL PLATFORM FOR CREATING RISK GROUPS FOR DEVELOPMENT OF OCCUPATIONAL DISEASES AND ANALYZING EFFECTIVENESS OF PREVENTIVE MEASURES

E.V. Zibarev, I.V. Bukhtiyarov, S.M. Vostrikova, O.K. Kravchenko, A.K. Bessonova, K.S. Mukhin

Izmerov Research Institute of Occupational Health, 31 Budennogo Ave., Moscow, 105275, Russian Federation

Introduction of digital solutions contributes to achieving the state's strategic priorities, including health promotion and extension of working life, which are implemented as part of the national program 'Digital Economy of the Russian Federation'. Therefore, one of the current tasks is to digitalize creation of risk groups per likelihood of occupational diseases and management of such health risks. However, due to existence of multiple methodological approaches, this task has not yet been resolved at the federal level.

The aim of the study was to create risk groups for development of occupational diseases according to hygienic and biomedical criteria and to assess effectiveness of preventive measures in people with early signs of occupational diseases.

In this study, a risk of developing occupational diseases means the probability of any developing occupational diseases, taking into account exposures, occupational factors and medical and biological indicators of workers' health status.

We analyzed the results obtained by periodic medical examinations before and after preventive measures. The study included data on 546 workers employed at metal ore mines (9.34 %) and in the transport sector (90.66 %).

Risk groups for development of occupational diseases were created according to the methodology for risk group formation based on results of periodic medical examinations; it was developed as an update of the main provisions stipulated in the Guide R 2.2.3969-23. Risk groups were formed for the following types of occupational diseases: sensorineural hearing loss (SNHL), vibration disease, and radiculopathy.

The analysis showed that most workers exposed to noise were classified into risk groups III (medium risk) (43.85 %) and IV (high risk) (49.72 %); when exposed to vibration, 58.68 % to group III; with increased work hardness, 51.27 % also to risk group III.

Effectiveness of preventive measures (rehabilitation, spa treatment) was assessed using indicators of individual and average total risk of occupational diseases. The most common chronic diseases and effective methods of prevention have been identified. The study also involved developing effectiveness criteria and algorithms for their assessment using the information platform.

Keywords: *occupational disease, risk group, analytical platform, individual total risk indicator, averaged total risk indicator, hygienic factors.*

The contemporary stage in development of the society and economy involves digitalization that penetrates most fields of human activity. Digitalization is a powerful factor influencing all key components of life quality including material conditions, health, education, occupational activity, quality of the environment, economic and social security. These ongoing changes require automation of various processes, occupational risk assessment included.

At present, there are various available automated systems for managing occupational

Evgeny V. Zibarev – Doctor of Medical Sciences, Deputy Director for Scientific Work (e-mail: zibarev@irioh.ru; ORCID: https://orcid.org/0000-0002-5983-3547).

Igor V. Bukhtiyarov – Honored Scientist of the Russian Federation, Academician of the Russian Academy of Sciences, Doctor of Medical Sciences, Professor, Director (e-mail: bukhtiyarov@irioh.ru; ORCID: https://orcid.org/0000-0002-8317-2718).

Svetlana M. Vostrikova – Candidate of Economic Sciences, Researcher (e-mail: vostrikovasveta@gmail.com; ORCID: https://orcid.org/0000-0003-1211-2926).

Olga K. Kravchenko – Candidate of Medical Sciences, Leading Researcher (e-mail: kravchenko_ok@inbox.ru; ORCID: https://orcid.org/0000-0001-6509-2485).

Anna K. Bessonova – Junior Researcher (e-mail: bessankonsta@gmail.com; ORCID: https://orcid.org/0009-0009-7215-0095).

Kirill S. Mukhin – technician (e-mail: dfozmor@yandex.ru; ORCID: https://orcid.org/0009-0005-7498-123X).

health risks [1–3]. They allow maintaining electronic circulation of documents on labor protection, creating a register of occupational hazards and hazardous objects, controlling issue of orders on accomplishment of specific work tasks, performing complex management of audit, and analyzing identified hazards within an actual organizational structure. Developed software packages make it possible to identify hazards at workplaces[1], to enter prior data into a map for occupational risk assessment per each workplace[2] in accordance with downloaded staff lists[3], to select relevant personal protective equipment[1], and to assess health risks together with creating a report and relevant documents in conformity with the requirements fixed in the labor protection legislation in the Russian Federation.[1,2]

Suggested digital instruments for occupational risk assessment are based on guidelines[4] for selecting a method of occupational risk assessment and are mostly aimed at assessing risks of injuries. They do not allow identifying risks of developing occupational diseases.

Despite a stable descending trend in occupational morbidity rates (in 2022, the occupational morbidity rate was 1.00 per 10,000 of employed people; in 2023, 0.96; in 2024, 0.89[5]), disability rates tended to grow: the total quantity of temporary disability days due to occupational diseases was 59,659 in 2022. Monthly payments to patients with occupational diseases equaled 2,733,146.7 thousand rubles per data provided by the Social Fund of the Russian Federation (SFR), which accounts for 0.24 % of its budget[6].

Several indicators are often used to establish risks of developing occupational diseases, including those specified in the Guide on Occupational Health Risk Assessment[7] (relative risk, etiological fraction, odds ratio [4–8]), occupational morbidity index [9], frequency of disease prevalence in workers from specific occupational groups against the control [10, 11], calculating prior risks of occupational diseases upon exposure to harmful chemicals using the individual boundary model [12]; also, failure mode and effect analysis (FMEA) is used [13]. It should be noted that the foregoing

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[1] ASU Tekhnoavia – SUPR [ASU Tachnoavia – SUPR]: No. 2022681349: State Registration Certificate for Software Package No. 2022681541 Russian Federation; submitted on November 11, 2022, published on November 15, 2022; applicant: Production and Introduction LLC “Firma “Technoavia” (in Russian).

[2] Aleshin A.V., Makeev A.I., Mukhanov V.V., Nosorev P.A. Avtomatizirovannaya informatsionnaya sistema «Laboratoriya riska» (AIS «RiskLab») [Automated Information System “Laboratoriya Riska” (AIS “RiskLab’)]: No. 2024684065: State Registration Certificate for Software Package No. 2024685319 Russian Federation; submitted on October 15, 2024, published on October 30, 2024; applicant: Russian Scientific Research Institute of Labor of the Ministry of Labor and Social Protection of the Russian Federation (in Russian).

[3] Moskvichev A.V., Bragin A.A., Titova A.P. Avtomatizirovannaya sistema «RiskProf: Okhrana truda» [Automated System “RiskProf: Labor Protection”]: No. 2024614435: State Registration Certificate for Software Package No. 2024615729 Russian Federation; submitted on March 06, 2024, published on March 12, 2024; applicant: Center for Research and Development on Labor Protection and Health LLC (in Russian).

[4] Ob utverzhdenii rekomendatsii po vyboru metodov otsenki urovnei professional'nykh riskov i po snizheniyu urovnei takikh riskov [On Approval of the Guidelines on selecting the methods for assessing levels of occupational health risks and their mitigation]: the Order by the Ministry of Labor and Social Protection of the Russian Federation issued on December 28, 2021 No. 926. *KonturNormativ*. Available at: https://normativ.kontur.ru/document?moduleId=1&documentId=411523 (May 11, 2025) (in Russian).

[5] O sostoyanii sanitarno-epidemiologicheskogo blagopoluchiya naseleniya v Rossiiskoi Federatsii v 2024 godu [On sanitary-epidemiological welfare of the population in the Russian Federation in 2024]: the State Report. Moscow, Federal Service for Surveillance over Consumer Rights Protection and Human Wellbeing, 2025, 424 p. (in Russian).

[6] O byudzhete Fonda pensionnogo i sotsial'nogo strakhovaniya Rossiiskoi Federatsii na 2023 god i na planovyi period 2024 i 2025 godov [On the budget of the Social Fund of the Russian Federation for 2023 and for the planned period of 2024 and 2025]: the Federal Law issued on December 05, 2022 No. 467-FZ. *Prezident Rossii*. Available at: http://www.kremlin.ru/acts/bank/48636 (May 18, 2025) (in Russian).

[7] Before September 07, 2023, the Guide R 2.2.1766-03 was used; after it, the Guide R 2.2.3969-23; Guide R 2.2.3969-23. Rukovodstvo po otsenke professional'nogo riska dlya zdorov'ya rabotnikov. Organizatsionno-metodicheskie osnovy, printsipy i kriterii otsenki [Assessment of Occupational Health Risk for Workers. Organization and Methodical Essentials, Principles and Assessment Criteria], approved by A.Yu. Popova, the Head of the Federal Service for Surveillance over Consumer Rights Protection and Human Wellbeing, RF Chief Sanitary Inspector on September 07, 2023. *YuIS Legalakt*. Available at: https://legalacts.ru/doc/r-223969-23-22-gigiena-truda-rukovodstvo-po-otsenke-professionalnogo/ (May 18, 2025) (in Russian).

methods are tailored to establish group risks and, except from the latest Guide R 2.2.3969-23 edition, do not make it possible to reveal personalized health risk.

Many studies report that generation and development of occupational diseases are influenced by working conditions (occupational and work-related factors and their exposure levels at a workplace), work records under exposure to an adverse factor [5–7, 12–14], bad habits, hypodynamia, and overweight [7, 8, 15–17].

In addition, development of occupational diseases is influenced by chronic diseases already present in a worker; for example, concomitant diseases aggravate the main disease in workers employed at aluminum production and suffering from occupational bronchopulmonary pathology [18]. Another study reported that most workers employed at glass fiber production, who had occupational diseases (local hyperkeratosis and malignant neoplasms of skin), were also diagnosed with diseases of the circulatory system (52.2 % and 80.0 % accordingly) [19].

Therefore, chronic non-communicable diseases in workers, especially when they are combined with behavioral risks (smoking or unhealthy diets), strengthen adverse effects produced by harmful workplace factors thereby increasing risks of occupational diseases and exacerbating their clinical course. All this confirms the relevance of developing a program for assessing risks of occupational diseases able to simultaneously cover hygienic and biomedical criteria.

The aim of this study was to create risk groups for development of occupational diseases according to hygienic and biomedical criteria and to assess effectiveness of preventive measures in people with early signs of occupational diseases.

Materials and methods. To create risk groups, we analyzed data provided by regional offices of the Social Fund of the Russian Federation (SFR) within implementation of a pilot project on prevention of occupational diseases among workers employed by economic entities with specific economic activities[8].

Workers were selected to participate in the pilot project considering the following: work records (longer than 7 years), mandatory exposure to adverse workplace factors (noise, vibration, or work hardness), as well as diseases associated with effects produced by these occupational exposures in a medical history.

Overall, 546 workers were examined; they were employed at metal ore mines (9.34 %) and in the land transport sector (90.66 %).

Risk groups were created relying on the methodology developed by the Izmerov Research Institute of Occupational Health and approved by the Ministry of Labor and Ministry of Health of the Russian Federation (August 27, 2024)[9] (hereinafter called Methodology). It is based on two hygienic and four biomedical indicators for occupational health risk assessment: indicator 1 is hazard class of working conditions (IN1); indicator 2, work records under exposure to harmful and / or hazardous occupational factors (IN2); indicator 3, early signs of disease (IN3); work-related chronic non-communicable diseases (CNCD) or other general somatic pathology or their signs (IN4); indicator 5, risk factors (RF) increasing likelihood of CNCD (IN5); indicator 6, medical prognosis of risk of disease and its clinical course (IN6).

One of five risk groups was established for workers based on these six indicators: Group 1, negligible risk; Group 2, low risk; Group 3, medium risk; Group 4, high risk; Group 5, extremely high risk [20].

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[8] O realizatsii pilotnogo proekta po provedeniyu profilaktiki professional'nykh zabolevanii rabotnikov v otdel'nykh vidakh ekonomicheskoi deyatel'nosti [On implementation of a pilot project on prevention of occupational diseases among workers employed by economic entities with specific economic activities]: the RF Government Order issued on February 01, 2023 No. 134. *Pravitel'stvo Rossii*. Available at: http://government.ru/docs/all/145955/ (July 11, 2025) (in Russian).

[9] Metodicheskie rekomendatsii po formirovaniyu grupp riska razvitiya professional'nykh zabolevanii na osnove rezul'tatov predvaritel'nykh i periodicheskikh meditsinskikh osmotrov (mediko-profilakticheskaya tekhnologiya) [Methodical guidelines for creating risk groups per occupational diseases based on the results obtained by preliminary and periodical medical examinations (medical and preventive technology)]. Available at: https://irioh.ru/doc/scie-report/MR_gruppy_riska_s_oformleniem_podpisan_v2.pdf (July 11, 2025) (in Russian).

Occupational health risks were assessed using such indicators as the individual total occupational risk (ITOR) (Formula 1) and the averaged total occupational risk (ATOR) (Formula 2).

$$ITOR = \sum_{i=1}^{6} GR_{INi}, \quad (1)$$

where GR_{INi} is the score value for the risk group per the i-th indicator.

$$ATOR = \frac{\sum_{i=1}^{N} ITOR_i}{N}, \quad (2)$$

where $ITOR_i$ is the level of the individual total occupational risk for the i-th worker determined after the periodical medical examination; N is the total number of workers who had the periodical medical examination.

To estimate effectiveness of rehabilitation / preventive activities, Methodology has the following indicators: indicator 7 for general (hygienic) preventive activities and indicator 8 for medical preventive activities.

Dynamics in the indicators ITOR and ATOR made it possible to estimate effectiveness of accomplished preventive investigations.

To make calculations, a software program was developed for creation of risk groups[10]; it allows for specific effects produced by harmful occupational factors on development of various occupational diseases[11].

Results and discussion. Risks of developing occupational diseases were qualitatively and semi-quantitatively assessed using the developed information platform. Risk groups were created for 546 workers with early signs of outcomes caused by exposure to harmful and / or hazardous occupational factors; of them, 65.57 % were exposed to elevated noise levels (62.63 % worked in cargo and passenger traffic operations and 94.12 % in mining industry); 43.22 %, elevated work hardness (37.37 % in traffic operations and 100 % in mining industry); 30.59 % were exposed to vibration (24.85 % in traffic operations and 86.27 % in mining industry). Using the program, risk groups were created for each worker per each indicator, the final risk group was identified and the ITOR indicator was calculated (Figure 1).

Risk groups per IN1 were identified depending on a level of harmful occupational exposure (a hazard class of working conditions per an occupational factor). Risk Group 2 prevailed:

[10] Aleshin A.V., Makeev A.I., Mukhanov V.V., Nosorev P.A. Avtomatizirovannaya informatsionnaya sistema «Laboratoriya riska» (AIS «RiskLab») [Automated Information System “Laboratoriya Riska” (AIS “RiskLab’)]: No. 2024684065: State Registration Certificate for Software Package No. 2024685319 Russian Federation; submitted on October 15, 2024, published on October 30, 2024; applicant: Russian Scientific Research Institute of Labor of the Ministry of Labor and Social Protection of the Russian Federation (in Russian).

[11] Astanin P.A., Zibarev E.V., Kravchencko O.K., Mukhin K.S. Programma dlya avtomaticheskogo formirovaniya grupp riska razvitiya professional'nykh zabolevanii na osnove rezul'tatov predvaritel'nykh i periodicheskikh meditsinskikh osmotrov [Software program for automated creation of risk groups of developing occupational diseases based on the results obtained by preliminary and periodical medical examinations]: No. 2023680196: State Registration Certificate for Software Package No. 2023681201 Russian Federation; submitted on October 03, 2023, published on October 11, 2023; applicant: Izmerov Research Institute of Occupational Health (in Russian); Bukhtiyarov I.V., Zibarev E.V., K.S. Mukhin [et al.]. Programma dlya formirovaniya grupp riska razvitiya professional'noi neirosensornoi tugoukhosti po rezul'tatam dispanserizatsii, predvaritel'nykh i periodicheskikh meditsinskikh osmotrov [Software program for creating risk groups of developing occupational sensorineural hearing loss based on the results obtained by preliminary and periodical medical examinations]: State Registration Certificate for Software Package No. 2025610409 Russian Federation; submitted on December 26, 2024; published on January 10, 2025; applicant: Izmerov Research Institute of Occupational Health (in Russian); Bukhtiyarov I.V., Zibarev E.V., Mukhin K.S. [et al.]. Programma dlya formirovaniya grupp riska razvitiya zabolevanii, svyazannykh s vozdeistviem obshchei vibratsii po rezul'tatam predvaritel'nykh i periodicheskikh meditsinskikh osmotrov [Software program for creating risk groups of diseases caused by exposure to total vibration based on the results obtained by preliminary and periodical medical examinations]: State Registration Certificate for Software Package No. 2025611200 Russian Federation; submitted on December 26, 2024, published on January 16, 2025; applicant: Izmerov Research Institute of Occupational Health (in Russian); Bukhtiyarov I.V., Zibarev E.V., Mukhin K.S. [et al.]. Programma dlya formirovaniya grupp riska razvitiya zabolevanii, svyazannykh s vozdeistviem lokal'noi vibratsii po rezul'tatam predvaritel'nykh i periodicheskikh meditsinskikh osmotrov [Software program for creating risk groups of diseases caused by exposure to local vibration based on the results obtained by preliminary and periodical medical examinations]: State Registration Certificate for Software Package No. 2025613411 Russian Federation; submitted on December 26, 2024, published on February 11, 2025; applicant: Izmerov Research Institute of Occupational Health (in Russian).

58.08 % of the examined workers (53.66 % in traffic operations, 70.45 % in mining) were assigned into it per exposure to vibration; per noise exposure, 75.98 % (75.81 % in traffic operations, 77.08 % in mining); upon exposure to elevated work hardness, 63.56 % (60.5 % in traffic operations, 74.5 % in mining).

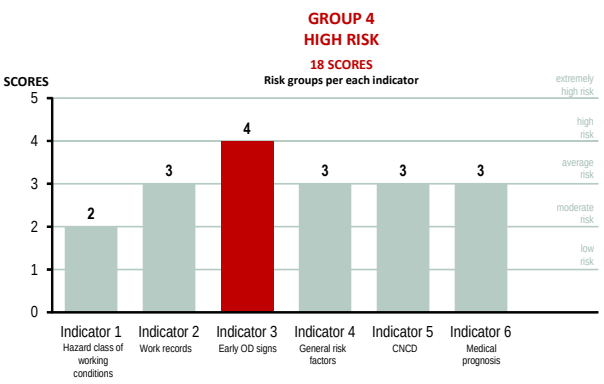

Figure 1. Diagram with the results of creating risk group using the analytical platform: an example

Among workers who had a periodical medical examination, 29 people (5.4 %) had work records of working under harmful working conditions below 10 years; 57 people (10.4 %), between 10 and 15 years; 100 people (18.4 %), between 15 and 20 years; 116 people (21.2 %), between 20 and 25 years; 244 people (44.6 %), longer than 25 years. No group with specific duration of work records prevailed among workers employed in land transport since most of them who had a periodical medical examination were evenly distributed in the following groups per work records: 15–20 years (21.6 %), 20–25 years (24.8 %) and longer than 25 years (34.7 %). The first two groups per work records (below 10 years and 10–15 years) together accounted for 19.9 %. As for miners, 95.9 % of them who had a periodical medical examination had work records longer than 25 years.

Early signs of outcomes caused by noise exposure were detected in 240 (43.96 %) of the examined workers (with the following diagnoses: H83.3 – Noise effects on inner ear, H90.3 – Sensorineural hearing loss, bilateral, Z57.0 – Occupational exposure to noise[12]). Three workers (0.55 %) had early signs of outcomes caused by exposure to vibration (diagnosed Z57.7 – Occupational exposure to vibration, T75.2 – Effects of vibration); 72 (13.19 %), early signs of outcomes caused by exposure to elevated work hardness with preliminary diagnoses including M53.8 – Other specified dorsopathies, M54.1 – Radiculopathy, M54.5 – Low back pain, Z57.8 – Occupational exposure to other risk-factors (Table 1).

Among the examined workers (546 people), the following disease classes prevailed: diseases of the musculoskeletal system and connective tissue (56.59 %), diseases of the circulatory system (51.83 %), diseases of the ear and mastoid (43.96 %), endocrine, nutritional and metabolic diseases (34.62 %) (Table 2).

Diseases of the circulatory system prevailed among miners (94.12 %); among transport workers, more prevailing classes of diseases included diseases of the musculoskeletal system and connective tissue (52.73 %), diseases of the ear and mastoid (48.48 %), and diseases of the circulatory system (47.47 %). Co-morbidity was identified in 57.47 % of the workers who had a periodical medical examination with three or more CNCD, work-related diseases or any other general somatic pathology diagnosed in them.

Most workers were included in Group 3 (medium risk) per the indicator 5 (55.58 %); for 39.67 %, risk factors were either absent (Group 1) or had low intensity (Group 2). Following the periodical medical examination, a favorable medical prognosis was made for 58.47 % of the examined workers (the indicator 6) and relatively favorable for another 29.87 %.

After the periodical medical examination, the workers were provided with some recommendations on medical and preventive activities: 295 workers were sent to have prevention of SHL (54.03 %); 175, prevention of radiculopathy (32.05 %); 52, prevention of vibration disease and SHL (9.52 %); 10 workers, prevention of SHL and radiculopathy (1.83 %).

[12] Professional'naya patologiya [Occupational pathology]: National Guide, 2nd ed., revised and supplemented. In: I.V. Bukhtiyarov ed. Moscow, GEOTAR-Media Publ., 2024, 904 p. DOI: 10.33029/9704-8177-6-PP2-2024-1-904 (in Russian).

Table 1

Workers' distribution in risk groups per IN3 (Early signs of occupational disease)

Risk group	Total		Transport		Mining	
	people	%	people	%	people	%
	SHL					
I	42	7.69	18	3.64	24	47.06
II	129	23.63	128	25.86	1	1.96
III	128	23.44	105	21.21	23	45.10
IV	54	9.89	54	10.91		
V	5	0.92	5	1.01		
Total	358	65.57	310	62.63	48	94.12
	VB					
I	115	21.06	104	21.01	11	21.57
II	33	6.04	8	1.62	25	49.02
III	13	2.38	10	2.02	3	5.88
IV	1	0.18			1	1.96
V	5	0.92			5	9.80
Total	167	30.58	122	24.65	45	88.23
	Radiculopathy					
I	64	11.72	37	7.47	27	52.94
II	75	13.74	75	15.15		
III	84	15.38	68	13.74	16	31.37
IV	12	2.20	4	0.81	8	15.69
V	1	0.18	1	0.20		
Итого	236	43.22	185	37.37	51	100

Table 2

Prevailing diseases diagnosed in the examined workers

Class of diseases	ICD-10 codes	The proportion of workers with the diagnose (%)		
		Total	Transport	Mining
Endocrine, nutritional and metabolic diseases	E00–E99	34.62	32.73	52.94
Diseases of the eye and adnexa	H00–H59	17.4	18.59	5.88
Diseases of the ear and mastoid	H60–H99	43.96	48.48	
Diseases of the circulatory system	I00–I99	51.83	47.47	94.12
Diseases of the digestive system	K00–K93	19.41	21.41	
Diseases of the musculoskeletal system and connective tissue	M00–M99	56.59	52.73	34.12
Diseases of the genitourinary system	N00–N99	10.44	11.52	
Factors influencing health status and contact with health services	Z00–Z99	12.27	13.54	

Non-drug therapies were more commonly used in rehabilitation with prevailing therapeutic exercises (including swimming pool and dosed walking) (84.09 % having SHL prevention; 87.17 %, radiculopathy prevention; 72.73 %, vibration disease prevention), classical massage (81.82 %, vibration disease prevention; 68.83 %; SHL prevention; 65.24 %, radiculopathy prevention); hypoxia therapy (oxygen cocktails and herbal infusions) (56.82 %, SHL prevention; 48.66 %, radiculopathy prevention; 36.36 %, vibration disease prevention), mineral baths (72.73 %, radiculopathy prevention; 56,49 %, SHL prevention; 36.36 %, vibration disease prevention), mud treatment (71.66 %, radiculopathy prevention; 63.64 %, vibration disease prevention; 52.92 %, SHL prevention) (Figure 2).

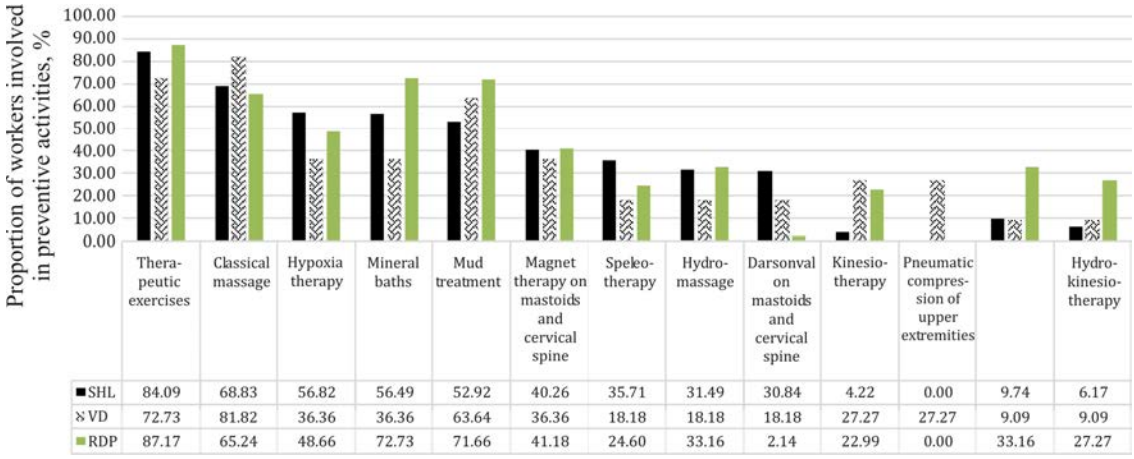

Figure 2. Prevalence of non-drug therapy in medical prevention of various diseases: SHL is sensorineural hearing loss, VD is vibration disease, and RDP is radiculopathy

The final risk group was established prior to medical prevention and after it. Most workers who had PME (periodical medical examination) were found to have medium risk (Group 3) of vibration disease (58.68 % prior to prevention and 56.89 % after it) and radiculopathy (51.27 % prior to prevention and 54.24 % after it). The workers were almost similarly distributed between risk Group 3 (43.85 %, 47.21 % prior to prevention and after it accordingly) and 4 (49.72 %, 45.53 % prior to prevention and after it accordingly) as regards sensorineural hearing loss (Table 3).

Group 4 as regards risk of vibration disease prevails among miners (63.64 % of workers exposed to vibration) and Group 3 – among workers employed in land transport (70.73 %). We did not establish any significant differences as regards SHL and radiculopathy in distribution per risk groups among miners and transport workers.

Table 3

Final risk groups (FRG) of three occupational diseases prior to prevention and after it (in absolute numbers and as % of the total number)

Risk group	Occupational disease					
	SHL	VD	RDP	SHL	VD	RDP
	Absolute number of people					
	FRG (prior to), people			FRG (after), people		
II	17	29	34	19	32	70
III	157	98	121	169	95	128
IV	178	35	67	163	37	28
V	6	5	14	7	3	10
Total	358	167	236	358	167	236
	% of the total number in each group					
	FRG (prior to)			FRG (after)		
II	4.75	17.37	14.41	5.31	19.16	29.66
III	43.85	58.68	51.27	47.21	56.88	54.24
IV	49.72	20.96	28.39	45.52	22.16	11.86
V	1.68	2.99	5.93	1.96	1.80	4.24
Total	100	100	100	100	100	100

Effectiveness of medical and preventive activities was estimated using the ITOR and ATOR indicators. The estimation revealed improvement in more than the half of the workers after prevention of vibration disease and radiculopathy, in 57.69 % and 63.98 % accordingly; no positive dynamics was established in 76.26 % after prevention of SHL (Figure 3).

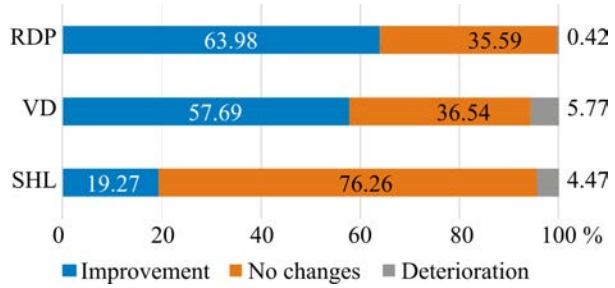

Figure 3. ITOR dynamics after medical preventive activities: SHL is sensorineural hearing loss, VD is vibration disease, and RDP is radiculopathy

In general, a decline in ATOR was established in all examined workers per all analyzed diseases; the highest effectiveness of preventive activities was achieved for transport workers in prevention of vibration disease (10.66%) and in prevention of radiculopathy for miners (5.08 %) (Figure 4).

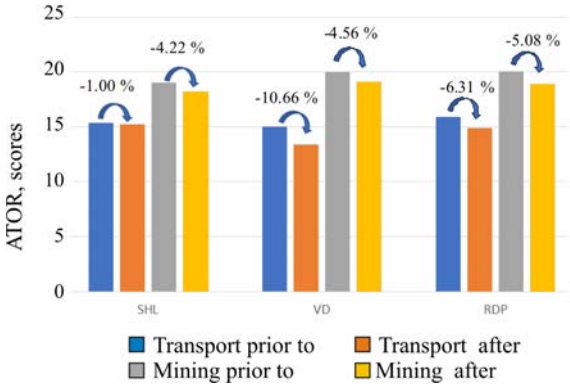

Figure 4. ATOR dynamics per occupational diseases: SHL is sensorineural hearing loss, VD is vibration disease, and RDP is radiculopathy

Use of the developed Methodology made it possible to reveal main indicators influencing the final risk group of developing occupational diseases. Regression analysis showed that the final risk group was predominantly influenced by early signs of occupational disease (IN3) (the regression coefficient 0.45 for SHL and VD risk and 0.37 for radiculopathy), work records under exposure to harmful working conditions (IN2) (the regression coefficient 0.42 for SHL and VD risk, 0.20 for radiculopathy) and comorbidity (IN4) (the regression coefficient 0.22 for radiculopathy). The analyzed data did not cover workers exposed to harmful working conditions with hazard classes above 3.2; therefore, the foregoing indicator (IN1) did not have any significant influence in the final risk group (the regression coefficient 0 for SHL and VD and 0.05 for radiculopathy).

The second creation of risk groups (following the preventive activities) revealed that the final risk group did not change in more than the half of the workers despite some improvements in their health. Thus, it did not change in 53–58 % of the workers with early SHL and VD signs or in 80 % of those with early radiculopathy signs despite certain improvements in these signs. That is, we cannot always make a well-grounded conclusion about effectiveness of accomplished preventing activities relying solely on a final risk group. To eliminate this drawback, we can use such indicators as an individual total occupational risk (ITOR) or averaged total occupational risk (ATOR), which are more sensitive to changes in components that constitute a final risk group.

Given substantial influence exerted on a final risk group by work records and comorbidity, we can assume that, despite provided preventive hygienic and medical activities, a final risk group will tend to become higher with time. In this respect, it is advisable to use the indicators 7 and 8 as stimulating ones that allow lowering a final risk group due to accomplished preventive activities.

Conclusion. Our analysis revealed the most frequent chronic diseases, including those diagnosed in transport workers and miners, as well as the most frequently used medical methods for rehabilitation of SHL, vibration disease and radiculopathy. We tested the developed methodology for creat-

ing risk groups of developing occupational diseases; as a result, risk groups were formed as regards developing SHL, vibration disease, and radiculopathy. Personalized and group (occupational) health risks were established using the methodology for creating risk groups of occupational diseases considering hygienic, biomedical, and prognostic indicators. This methodology allowed making not only qualitative assessment of occupational risks (low, medium, or high risk) but also their semi-quantification (the ITOR and ATOR indicators). Effectiveness of accomplished preventive activities was estimated using the suggested indicators, both personalized (ITOR) and for an enterprise as a whole (ATOR). The developed methodology made it possible to reveal non-occupational factors with the greatest influence on risk of developing occupational diseases. All the foregoing indicators were calculated using an automated software package; these calculations are not only an integral part of occupational health risk assessment but also represent a whole system for analyzing data on each worker in dynamics. This makes it possible to use it as an analytical platform for making management decisions as regards each individual worker.

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