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Mental health of chemical workers: violation risk factors

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Abstract

Aim. To study the structure of psychosocial maladjustment in chemical workers and assess the contribution of industrial and non-industrial risk factors in the formation of mental illness.

Methods. It was analysed of hygienic assessment of the leading harmful production factors — chemical, physical, factors of severity and intensity of labor. During the periodic medical examination, the mental health status of 1,226 people was examined, with a focus on professional experience, mental hygiene aspects of production factors, as well as individual and personal characteristics of employees. Confidence intervals and standard errors estimating, the logistic regression models fitting were performed using R Statistical Software with significance level 0.05.

Results. The working environment hazards in organic synthesis included chemical risk factor, continuous noise exceeding the permissible exposure limit, emotional stress and life-threatening conditions (fire and explosion hazards in the work). The general assessment of working conditions was performed using clauses 5.1–5.11 P 2.2.2006-05-harmful working conditions of the second-third degree (3.2–3.3). Working conditions at all stages of the manufacturing process of pyroxylin powders were assessed as harmful to the third-fourth degree (3.3–3.4), including the chemical factor, the severity and intensity of work, fire and explosion hazards in the work. It was revealed the dependence of the development of psychosocial maladjustment on non-work-related factors (such as the level of education, marital status), conditional work-related factors (level of material security). Also, the dependence of the structure of pre-existing mental health condition on the work-related and developmental characteristics (work experience) of labor in chemical production was found.

Conclusion. Working conditions in the studied industries correspond to the 3rd harmful class, 2nd and 3rd degrees in the production of organic synthesis (3.2–3.3), while at the production of pyroxylic powders, it is close to dangerous (3.3–3.4); the structure and risk of the developmental process of employee maladjustment are determined by the feature effect of workplace hazards.

Keywords: mental health, chemical production, adverse working conditions, psychosocial maladjustment, employee health, occupational disease.

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Background

A review of the national and international literature confirms the problems associated with the assessment and management of mental health of the working population and the measures to prevent its deterioration.

In 2005, the European Declaration on mental health care—"Problems and solutions" (Helsinki, 12–15.01.2005)—published following the meeting of the member countries of the World health organization (WHO), called for "the need to include mental health care issues connected with working practice in occupational health and safety programs" [1].

According to a recent study, under the guidance of the WHO, the decline in the productivity associated with depression and anxiety disorders costs the global economy $ 1 trillion annually. Multiple risk factors for mental health disorders may be associated with the working conditions. Some activities may be characterized by a higher risk to the employees that can lead to negative effects on their mental health and symptoms of mental disorders. Workers in chemical production, who have a long-term contact with harmful substances at the workplace, are susceptible to the development of chronic intoxication that sometimes goes unnoticed by the employees.

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The term "environmental health" 2010 [2], has long gone beyond the concept accepted by the international community and includes the theory and practice of assessing, correcting, controlling, and preventing environmental factors that may threaten the health of the present and future generations. In the modern understanding of occupational medicine, this term is widely applied to the state of health of the employees [1].

The global community recognizes that individual interventions based on practice and research are needed to help maintain good mental health and well-being at the workplace. On March 25, 2010, at its 307th session, the administrative council of the International Labour Organization (ILO) approved a new list of occupational diseases [3]. The ILO list included psychoemotional and behavioral disorders if a direct link was established between the exposure to risk factors and the development of such disorders in the employee.

Considering the increased number of anxiety and depressive states worldwide, the risk of which is directly related to socio-psychological factors, development of a mental healthcare model in the Russian Federation by 2025, approved by a Presidential Decree No. 254 dated June 6, 2019 was strategized [4]. Psychosomatic diseases are becoming widespread among the population due to several psychological factors, insufficient stress resistance, and long-term psychoemotional stress. These disorders significantly reduce the quality of life and lead to long-term disability by the addition of concomitant diseases, including dependence on alcohol and other psychoactive substances. Consequently, the prevention of mental and behavioral disorders is important for the prevention of noncommunicable diseases among the population of the Russian Federation.

The main guidelines of the strategy are as follows:

– Improved detection and prevention of depressive, anxiety, and post-stress disorders;

– Improvement of dispensary monitoring, including an online dispensary monitoring using information technology for patients with non-communicable diseases, including mental disorders;

– Increasing the availability of psychological and psychotherapeutic assistance.

According to WHO, mental disorders will be included in the top five diseases leading to disability in 2020 [5]. About 15% of the global working population needs psychiatric care; in Russia, this value is close to 25% [6].

Numerous sources provide scattered information about the impact of working conditions on the mental health of workers. Domestic experience in conducting epidemiological studies also confirms that the most accurate data on the prevalence of mental disorders can be obtained by continuous psychoprophylactic examination of employees during the surveys conducted at their place of work [7].

The prevalence of mental pathology in the population detected officially by traditional approaches was determined as 10:1 [8]. The nature of work at chemical industries; including physical labor (the severity and intensity of work), life-endangering tasks (working with explosives and at high temperatures), and negative environmental factors; render their employees at an increased risk of developing mental disorders. Their work profiles are one of the most stressful in emotional and psychological terms.

Aim. Study of the nature of mental maladaptation of workers at chemical production facilities and the assessment of the contributing industrial and non-industrial risk factors for mental health disorders.

Materials and methods

For the period from 2012 to 2018, the authors conducted a continuous cohort study to carry out a comprehensive survey of the state of mental health of workers involved in chemical production in the industries in Republic of Tatarstan. The first group (group I, n = 673) included employees at the PAO Kazan organic synthesis facility. In the second group (group II, n = 201), employees involved in the production of a pyroxylic gunpowder were examined at the FKP Kazan state gunpowder factory. The third group (group III, n = 352) was a control group that included employees at the auxiliary divisions (without any exposure to chemical factors) of a telecommunications company.

The work was approved by the ethics committee of Kazan State Medical University (report No. 2 dated 03.03.2020).

The study parameters included the chemical and physical production-related factors, the intensity of the manual labor (n = 584), and the general class of working conditions according to the manual P.2.2.2006-05 [9]. An occupational risk was assessed per the "Guidelines for the assessment of occupational risk of the health of employees. Organizational and methodological bases, principles and evaluation criteria" P 2.2.1766-03 [10].

The study included employees of both sexes, aged 20 years and older, with a work experience not less than 1 year. All participants gave written informed consent to undergo periodic medical examinations as established by the order of the Ministry of Health Care and Social Development of the Russian Federation dated 12.04.2011 №302n

Table 1. General assessment of working conditions of workers according to the degree of harm and danger*

Production	Profession	Class of working conditions by intensity of factors					General class
		chemical	noise ($_{LEQ}$)	microclimate	the severity of work	the intensity of work	
Production of ethylbenzene (Group I)	Operator, n = 27	3.1	3.1	2	2	3.1	3.2
	Maintenance man, n = 51	3.2	3.2	2	3,2	2	3.3
The production of ethylene, propylene (Group I)	Operator, n = 13	3.1	3.1	2	2	3.1	3.2
	Maintenance man, n = 35	3.2	3.2	2	3.2	2	3.3
The production of pyroxylin powders (Group II)	Dehydration, n = 36	3.1	2	2	3.2	3.2	3.3
	Plasticization, n = 38	3.4	2	2	3.2	3.2	3.4
	Pressure testing, n = 36	3.4	2	2	3.2	3.2	3.4
	Cutting, n = 48	3.2	2	2	3.2	3.2	3.3
Telecommunications company (Group III)	Supporting, n = 96	2	2	2	2	2	2

Note: * guidelines for the hygienic assessment of working environment and labor process factors; criteria and classification of working conditions (guidelines P 2.2.2006-05).

that states: "About the approval of lists of harmful and (or) dangerous production factors and works, under which compulsory preliminary and periodic medical examinations (surveys), and the procedure for conducting of mandatory preliminary and periodic medical examinations (examinations) of employees engaged in a heavy work and work with harmful and (or) dangerous working conditions" [11].

For more information, we studied the "Medical card of an outpatient" (form N025/u-04). The examination of professional fitness was conducted periodically by the Chairman of the medical commission; a professional pathologist.

At the next stage, collection and analysis of anamnestic and hereditary data and specially designed questionnaires were used. Employees of all three groups (n = 1226) underwent the following tests:

– Clinically structured psychiatric interview;

– Survey to identify additional non-production-related risk factors;

– Assessment of neurotic states using a questionnaire to identify them (K.K. Yakhin, D.M. Mendelevich) [12];

– Assessment of the mental state by studying the perception of time (Zaitsev O.S., Krasnov V.N.) [13];

– Lusher's method of color choices (L. N. Sobchik's method) [14].

Statistical analysis was performed using the statistical program R [15]. Logistic regression models were constructed to study relationships and calculate probabilities [16, 17], confidence intervals and standard errors were calculated for the significance level of 5%.

Results

For meaningful comparisons, the first two groups were considered as the main groups. Based on their working conditions at different industries, the groups were exposed to the following factors:

1) Group I: complex chemical factors, production noise, and emotional overload;

2) Group II: complex effects of chemicals and high intensity physical labor;

3) Group III was the control group comprising employees who were not exposed to negative production-related factors and worked in acceptable conditions.

Table 1 presents the data on the general assessment of working conditions of employees according to the degree of harm and danger.

The main components of air pollution in the working area of the organic synthesis production facility were aliphatic compounds and unsaturated hydrocarbons. Additionally, aromatic hydrocarbons including, methanol, dimethylformamide, formal-

dehyde, 4,4-dimethyl-1,3-dioxane, and others that differed in the degree of toxicity and the nature of action were found. The maximum single concentrations of harmful substances exceeded the established standards by 1.8–3.0 times. The intensity of industrial noise in some workplaces exceeded the permissible levels by 5–20 dBA.

The nature of work of group I employees can be characterized as "stressful" due to the exposure to explosives and high temperatures, the potential danger of accidents, performing complex tasks, and the duration of concentrated observation >50%–55% of the shift time (class 3.2); and "heavy" due to the large volume of manual operations, lifting and moving of up to 35 kg of weight, and staying in a forced working position for up to 30% of the shift time (class 3.2). The general class of working conditions in this group was 3.2–3.3.

The technology for the production of pyroxylic powders has remained virtually unchanged for many decades, with a level of mechanization of about 65%. The mass of goods regularly moved by the employees during the production process does not meet the safety standards, reaching up to 39.9 kg when the combined mass of containers and their products (trays, frames, etc.) is considered.

In addition to the significant severity of the manual labor, the working conditions of group I employees were characterized by a high degree of psychological stress due to their exposure to explosives and extremely high temperatures. Along with diethyl ether and ethyl alcohol in the air, during plasticization and pressing operations, acetic acid and diphenylamine vapors were detected above the maximum permissible concentration.

Group II employees were exposed to a combination of negative production-related factors (increased content of harmful substances above the maximum permissible concentration, high temperatures and relative humidity) and manual labor (significant physical dynamic load, lifting and moving heavy loads, frequent body tilts, emotional stress). Working conditions at all stages of the pyroxylin powder manufacturing process can be assessed as harmful to the 4th degree (3.4).

All the surveyed groups were similar in their non-production-related characteristics (sex, family status, education, etc.). The average age and work experience in production of the surveyed employees was 43 ± 13.3 years and 12.2 ± 10.01 years, respectively. No statistically significant differences were observed among all the groups in terms of their socio-demographic characteristics, geography of residence, and workflow schedule (table 2). This made it possible to draw a valid comparison regarding the impact of production-related factors on the mental health of the employees among the groups.

According to the results of the survey, two subgroups were identified among each professional group; namely, people with a stable mental adaptation and those with an unstable mental adaptation or maladaptation. With this approach, we were not considering the diagnosis of painful conditions; however, we considered the quantitative and qualitative analysis of those signs that can occur both in healthy people and in patients with non-psychotic disorders. The frequency of occurrence of various types of mental maladaptation among workers in different working conditions, in terms of the working environment and manual labor, was analyzed. The results showed that the proportion of people with mental maladaptation between the main and control groups differed significantly ($p < 0.05$). The rates of maladaptation observed in groups I and II were 23–104 per 1000 and 139–330 per 1000 people, respectively.

Analysis of the relationship between mental maladaptation and the impact of non-production-related factors showed that the probability of maladaptation among women was significantly higher than in men. In the main group, single and married people were generally happier than those who were divorced or widowed.

Employees in the main group who had a higher level of education were significantly more likely to exhibit almost all variants of mental maladaptation than those with secondary level of education [anxiety, 5.9 ± 0.096 vs. 5.5 ± 0.100 ($p = 0.01$); neurotic depression, 4.7 ± 0.12 vs. 4.2 ± 0.12 ($p < 0.01$); asthenia, 7.3 ± 0.10 vs. 6.7 ± 0.10 ($p < 0.01$); obsessive-phobic disorders, 4.2 ± 0.082 vs. 3.8 ± 0.084 ($p = 0.01$); and vegetative disorders, 10.6 ± 0.18 vs. 9.9 ± 0.19 ($p = 0.03$), respectively]. This may be due to the greater responsibility and emotional stress of the profession in the former. However, for conversion-type reactions that included symptoms such as shortness of breath, discomfort in the chest during unrest (35%), swallowing (38%), increased sensitivity (33% and 34% among group II and I employees, respectively), swallowing (22%) and stomach pain in case of anxiety (15%), no significant differences were noted between the former and latter (probability of 4.6 ± 0.099 vs. 4.3 ± 0.102, $p = 0.09$).

According to our observations, the highest chances of developing mental maladaptation were seen in men and women with 5–10 and 10–15 years of work experience, respectively; wherein they were chronically exposed to subtoxic doses of complex chemical organic compositions, explosives, and high temperatures [18]. Compared with the control group, the group I employees with up to

Table 2. Socio-demographic characteristics

Social charactersitcs		The first group (n = 673)		The second group (n = 201)		The third group (n = 352)	
		n	%	n	%	n	%
Sex	male	527	78.31	48	23.88	148	42.05
	female	146	21.69	153	76.12	204	57.95
Age, years	21–30	190	28.23	7	3.48	84	23.86
	31–40	160	23.77	31	15.42	77	21.88
	41–50	190	28.23	52	25.87	107	30.40
	51–60	124	18.42	92	45.77	79	22.44
	61 and older	9	1.34	19	9.45	5	1.42
Experience, years	1–4	234	34.77	8	3.98	69	19.60
	5–14	294	43.68	69	34.33	146	41.48
	15 and more	145	21.55	124	61.69	137	38.92
Education	incomplete secondary	14	2.08	8	3.98	1	0.28
	secondary special education	362	53.79	157	78.11	58	16.48
	higher education	278	41.31	34	16.92	283	80.40
	incomplete higher education	19	2.82	2	1.00	10	2.84
Marital status	single	130	19.32	29	14.43	68	19.32
	married	480	71.32	138	68.66	232	65.91
	divorced	51	7.58	21	10.45	37	10.51
	widow	12	1.78	13	6.47	15	4.26
Family relationships (FAM.REL)	good	653	97.03	193	96.02	348	98.86
	conflict	20	2.97	8	3.98	4	1.14
Satisfaction with your family life	yes	637	94.65	178	88.56	338	96.02
	no	36	5.35	23	11.44	14	3.98
Financial support of the family	sufficient	212	31.50	83	41.29	167	47.44
	insufficient	155	23.03	43	21.39	48	13.64
	satisfactory	306	45.47	75	37.31	137	38.92

4 years of experience were at significantly higher risk for the development of mental maladaptation (0.750 ± 0.217, $p \leq 0.005$) that can be explained by the possible departure of these workers from their profession once their symptoms surfaced.

In group II, the probability of a maladaptation was significantly reduced during the 5^{th}–14^{th} year of work (0.140 ± 0.020, $p \leq 0.005$) that was consistent with the data of N.F. Izmerov (1998) regarding the effect of the absence of production-related factors. However, from the 15^{th} year of work, the probability of maladaptation increased again (0.175 ± 0.032, $p \leq 0.005$); confirming the hypothesis regarding the influence of production-related factors on the development of mental health disorders (table 3).

The level of the economic security and material compensation for the harmful working conditions at the industries pertaining to "organic synthesis" significantly exceeded (in general, as in the sphere related to the oil and gas complex) that of the industries pertaining to the production of pyroxylic powders. We considered this as an important factor that influenced the development of mental health disorders that was confirmed by a statistically significant difference between the subjective assessment

Table 3. The probability of the formation of maladaptation depends on experience

Experience, years	The first group (n = 673)	The second group (n = 201)	The third group (n = 352)
1–4	0.150±0.023	0.750±0.217*	0.145±0.042
5–14	0.140±0.020*	0.394±0.085	0.253±0.036
≥ 15	0.175±0.032*	0.450±0.056	0.358±0.041

Note: *$p \leq 0.05$.

Table 4. Factor analysis of the structure of borderline mental disorders depending on the work experience at chemical production facilities

	Experience up to 9 years			Experience 10–14 years			Experience 15 years and more		
The first group	factor loads								
Scale of the questionnaire	factor 1	factor 2	factor 3	factor 1	factor 2	factor 3	factor 1	factor 2	factor 3
Alarm	0.77*	0.27	0.26	0.4	0.83*	0.39	0.32	0.89*	0.3
Psychotic depression	0.35	0.54*	0.45*	0.72*	0.28	0.43*	0.8*	0.27	0.36
Asthenia	0.34	0.29	0.89*	0.28	0.28	0.76*	0.71*	0.39	0.26
Conversion type of response	0.34	0.83*	0.25	0.82*	0.32	0.21	0.65*	0.37	0.4*
Obsessive-phobic disorders	0.54*	0.36	0.27	0.55*	0.49*	0.23	0.49*	0.54*	0.24
Autonomic disorders	0.58*	0.48*	0.37	0.71*	0.37	0.45*	0.44*	0.36	0.82*
% of dispersions	27%	25%	22%	37%	22%	20%	35%	26%	19%
The second group	factor loads								
Scale of the questionnaire	factor 1	factor 2	factor 3	factor 1	factor 2	factor 3	factor 1	factor 2	factor 3
Alarm	0.72*	0.41*	0.49*	0.29	0.91*	0.28	0.36	0.89*	0.26
Psychotic depression	0.29	0.91*	0.28	0.81*	0.32	0.14	0.68*	0.33	0.42*
Asthenia	0.72*	0.54*	0.28	0.52*	0.54*	0.38	0.41*	0.26	0.87*
Conversion type of response	0.43*	0.48*	0.76*	0.91*	0.19	0.35	0.79*	0.32	0.36
Obsessive-phobic disorders	0.71*	0.23	0.29	0.29	0.31	0.91*	0.63*	0.48*	0.29
Autonomic disorders	0.66*	0.21	0.61*	0.72*	0.53*	0.3	0.63*	0.38	0.48*
% of dispersions	38%	27%	24%	41%	27%	21%	36%	24%	23%

Note: * significant factor load.

of material security and the probability of developing mental maladaptation in the main groups.

The probability of mental maladaptation was significantly higher in group II employees who assessed their level of material security as insufficient and satisfactory (0.652 ± 0.099, $p \leq 0.005$; 0.548 ± 0.077, $p \leq 0.005$, respectively) with a small subjective difference between the two levels (according to the employees; regarded as "preferably more").

In group I employees, the probability of forming a mental maladaptation of workers with insufficient material support was significantly higher (0.209 ± 0.033, $p \leq 0.005$). This was confirmed by the nature of complaints about "lack of confidence in the future," ideas of low value, the expressed component of anxiety—"difficulty falling asleep" (44%), and anxiety and concern for someone or something (66%).

For a detailed analysis of the nature of mental disorders at the prenosological level, depending on the nature of production-related factors, a factor analysis (using varimax-rotation) of the survey results was performed; taking into account the work experience at the existing establishments.

The results of the factor analysis (table 4) show that in people with work experience up to 9 years, under the influence of chemical factors, noise, and emotional loads, the selected factors can be considered to be responsible for the mental maladaptation of individuals leading to character accentuations of the anxiety type (factor 1), conversion type (factor 2), and asthenic type (factor 3).

Along with characterological reactions, the first two factors include vegetative appearances, while 2nd and 3rd factors include depression and obsessive-phobic disorders (factor 1). Similarly, although more clearly, this regularity is seen in the 10–14 year work experience group that commonly exhibited conversion type of responses, depression,

vegetative disorders, phobia (factor 1), the relationship of anxiety with phobic disorders (factor 2), as well as the relationship of asthenovegetative disorders with obligate depressive disorders (factor 3).

The obtained results confirm the clinical data about faster decompensation, under conditions of a combined noise exposure with emotional stress and chemical factors, in people, with anxiety-depressive and conversion traits, who have decompensated already in the first 5–10 years of work. For employees with more than 15 years of experience, the formation of a general neuroticism is specific; confirmed by the data of the factor analysis, wherein the 1st and 2nd factors have quite high loads across all scales.

Evaluation of the results of the factor analysis of employees, whose work was characterized by exposure to chemical factors, high temperatures, and explosives showed that the borderline neuropsychiatric disorders identified in the first 9 years of work were closely related with characterological features, including appearance of asthenovegetative and anxiety-phobic disorders (factor 1). Among these people, the structure of factor 2 indicated the predominance of a neurotic depression also in combination with appearances of asthenic disorders and conversion type of reactions. Factor 3 included conversion disorders with vegetative appearances of the anxiety type.

With an increase of work experience to 10–14 years, the structure of the 1st factor comprised predominantly the conversion (displacement) reaction type with the maximum factor load. The inclusion of depressive and asthenovegetative disorders in the structure of this factor indicated a tendency to form disorders of adaptive responses—F43.2—according to the International classification of diseases of the 10th revision (ICD-10) [19]. Factor 2 included anxiety disorders with a maximum factor load and asthenovegetative disorders with a lower one that complemented the structure of this factor. The 3rd factor showed the maximum load on the scale of obsessive-phobic disorders, acting in isolation; indicating its independence from other disorders.

For employees with greater than 15 years of experience, the factor structure became different: high on almost all scales with a predominance of the conversion type of a response, supplemented by interdependence of depressive, obsessive-phobic, and vegetative disorders that showed a tendency toward general neuroticism, differing in structure (factor 1). The 2nd factor included an anxiety radical linked to obsessive-phobic reactions, while in the 3rd factor an asthenic component was distinguished, supplemented by vegetative disorders with depressive symptoms.

Thus, factor analysis of the results of the screening survey, considering the experience characteristics of the main groups, allowed us to clearly define the dynamics of the development of the structural states of mental maladaptation. Cross-cutting leading syndromes among employees of the first group were characterological conversion reactions that were, in the initial years, combined with anxiety-phobic symptoms and asthenovegetative reactions. With increasing length of service, the structure of borderline neuropsychiatric disorders becomes more complex, and subsequently an expressed neuroticism was formed with a predominance of a depressive-asthenic characterological reaction of avoidance.

For people working under conditions of exposure to chemical factors, explosives, and high temperatures, asthenovegetative symptoms in combination with the personal type of conversion responses were predominant. Concurrently, in the first 9 years of experience, there were general neurotic reactions with an expressed contribution across all scales, indicating the influence of adaptive mechanisms up to the formation of decompensation. Further, with increasing experience, they were transformed into a conversion type of reaction of the somatovegetative type with phobic radical components and obsessions that were subsequently revealed to be relatively independent from characterological reactions.

Discussion

Our study showed that not only production-related factors in general, but also the evolutionary and temporary (experience) characteristics determined the different mechanisms for the development of mental health disorders.

Considering the international and national literature and the findings of our own study, it is necessary to include these factors, which may prove harmful in the long run, for determining the nature of the working conditions. Establishments that require intense manual labor should enforce preliminary and periodic medical examinations of their employees. To achieve this, it is necessary to change the approaches for the assessment of working conditions by evaluating the intensity of the requisite manual labor and the intellectual, sensory, and emotional factors.

Advancements in science and technology have done much to save people from the effects of ill-health. However, not all the negative factors of an establishment can be eliminated at once. The revealed mechanisms of the formation of mental adaptation disorders require domestic specialists, in the field of occupational medicine, and specialists in the field of psychiatry to continue working toward “industrial” psychiatry; develop common

criteria for assessing the mental health of workers in harmful production-related conditions to implement appropriate measures of prevention of disorders and establish psychohygiene.

The goal should be to develop common diagnostic criteria corresponding to class F40–F48 (ICD-10) that can be applied for diagnosing an occupational disease. This measure will allow the integration of mental maladaptation into the list of occupational diseases of the Russian Federation item 2.4—"Mental and behavioral disorders"—approved by the ILO in 2010 [3].

In anticipation of adaptation of ICD-11 [20] in domestic practice, drafted the order "On approval of lists of harmful and (or) dangerous production factors and works, under which compulsory preliminary and periodic medical examinations (surveys) are carrying out, and the order of carrying out of obligatory preliminary and periodic medical examinations (surveys) of workers on heavy works and on works with harmful and (or) hazardous labor conditions," it is necessary to consider factors such as intensity of work and emotional load, in relation with other factors responsible for the development of mental health disorders in various professions.

Conclusion

1. The working conditions of employees at chemical industries involved in organic synthesis correspond with the 3rd harmful class of the 2nd and 3rd degrees classifications of workplace safety guidelines (3.2–3.3), and include chemical factors, constant noise, and emotional stress. In the industries involved with the production of pyroxylic powders, these are close to dangerous (3.3–3.4), and include chemical factors, the severity of manual labor, and emotional stress.

2. The nature and risk of mental maladaptation of employees are determined by the characteristics of exposure to harmful production-related factors, they depend on the level of education, marital status, economic security, and evolve with increased work experience (length of service in harmful conditions).

Authors' contributions. S.V.K. conducted the research, was responsible for the collecting and analysis of the results, and was the coordinator of the work; R.V.G.—a scientific consultant (the section of an occupational medicine); R.V.G. and Z.M.B.—participated in the collection of the results; K.K.Y.—a scientific consultant (the section of psychiatry).

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