
Adaptive capacity of workers depending on working conditions by industry of the republic of kazakhstan

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Abstract: The problem of ensuring safe working conditions and maintaining the working capacity of employees of enterprises is important in any economic sector. This is a broad and complex task requiring coordinated joint work of labor protection specialists, hygienists, trade union workers, etc. In Kazakhstan, unfortunately, despite the measures taken, there remains a high proportion of those working in hazardous working conditions, which in some sectors reaches 65-70%. In this regard, it is of interest to study the adaptation process, that is, to increase the body's resistance to external factors, and to control these processes. Purpose: to assess the impact of working conditions on the adaptive potential of the body of workers by comparing hemodynamic parameters (blood pressure, heart rate) and adaptation (adaptive potential of the circulatory system, physical condition index, body mass index), taking into account the working conditions of production personnel at enterprises of construction, mining and manufacturing, transportation and agriculture. Methods. When studying the problems of adaptive potential, a biomedical approach was used, i.e. comparison of indicators of the functional state of the body and the ability to adequately respond to adverse factors of the working environment. The assessment of the adaptive potential of workers was carried out according to a method based on measuring height, body weight, heart rate at rest, systolic and diastolic blood pressure. Results. The adaptive potential of the body of 296 surveyed workers (166 professions, age 31-70 years), most of them are assessed as satisfied (43%), at the same time, there is an unsatisfactory adaptation in 15%, failure of adaptation in 5% of workers. Conclusions: Harmful working conditions lead to a deterioration in the functional state and depletion of the adaptive reserves of the body of workers. In this regard, timely preventive measures are needed to preserve the working capacity of workers. This method can be used as an express method for assessing the functional state of workers.

Keywords: working conditions, occupational risk, functional state, adaptive potential of the organism.

INTRODUCTION

The main directions of the state policy in the Republic of Kazakhstan on labor protection issues provide for ensuring safe working conditions at work, preventing and preventing industrial injuries and preserving human life and health during work (16). Despite the measures taken, enterprises in the Republic of Kazakhstan have negative dynamics of such indicators as the number of employees in harmful and (or) dangerous working conditions, the level of industrial injuries, including fatal ones, and the number of occupational diseases. At the moment, in the Republic of Kazakhstan out of 1.6 million in 2018, 373 thousand or one in four (22.3%) employees employed in the surveyed enterprises in terms of working conditions worked in harmful and

dangerous working conditions (19). In General, the professional activity of a person is largely associated with the impact on the body, both physical exertion and nervous and emotional stress and in certain production conditions it is affected by unusual environmental factors that affect its General condition, well-being and performance (17, p.49). According to the authors, working conditions in the workplaces of employees, depending on the degree of excess of hygiene standards, can have an adverse effect on the body and cause functional changes, which stop when contact with harmful factors is interrupted (7, p.46).

Therefore, it is very important to introduce methods of prenosological diagnostics as a preventive tool in making preventive decisions. After all, as you know, it is better to warn! One of the most promising approaches is the approach when the prenosological condition is considered as the result of a decrease in the adaptive capabilities of the body, which precedes the development of pathology. This is the approach suggested by P. M. It is a fairly simple but informative method of measuring adaptive potential, the effectiveness of which in mass research is shown in the work of V. M. Baranov et al. (2, p. 26). This approach is widely used and has been further developed in a number of works, one of which substantiates modern concepts of health based on the development of the ability to adapt, requires personalization and a preventive approach in assessing and predicting individual health (3,p.1188).

In work of S. A. Syurina and A. A. Kovshova, based on data from the socio-hygienic monitoring for 2007-2017, was found that the most common dangerous and harmful production factors at workplaces of enterprises are noise, the severity and intensity of the labor process, chemical factors, leading to the development of professional pathology, which is often diagnosed in workers of mining and metallurgical enterprises. Taking into account the tendency to increase the indicators of occupational morbidity, it is concluded that it is necessary to improve the system of social and hygienic monitoring and develop more effective methods of prevention of occupational diseases (15, p. 20-21).

The purpose of the study is to assess the impact of working conditions on the adaptation potential of the body of workers by comparing hemodynamic indicators (blood pressure, heart rate) and adaptation (adaptation potential of the circulatory system, physical condition index, body mass index), taking into account the working conditions of production personnel in the construction, mining and manufacturing industries, transport and agriculture.

During the study, the following tasks were solved: the collection, systematization and processing of data on the state of occupational injuries and occupational diseases in the industry and for the studied enterprises, including hemodynamic indicators (blood pressure, heart rate of the circulatory system) and anthropometric data (physical condition index, body mass index), taking into account the working conditions of industrial personnel in the construction, mining and manufacturing industries, transport and agriculture. An assessment of the adaptive capabilities of the body of workers in comparison with the leading harmful factors of the production environment and the labor process is given, and the need for corrective and preventive measures is determined.

Research materials and methods

In the course of the study, in the context of sectors of the economy of the Republic of Kazakhstan with a high level of injuries and occupational diseases, scientific research was conducted at the production facilities of 20 enterprises (information collection, technical inspection, measurement of production factors and assessment of adaptation potential). The research belongs to the experimental type, which is characterized by the collection of primary information, its processing and conclusions. Method of selecting study participants. The total number of enterprises studied was 20, including agriculture-5 enterprises, transport industry-3, manufacturing - 8, construction-3, mining - 1 enterprise. The study involved 269 employees of 166 professions, aged 31 to 70 years. Measurement methodology. Assessment of the harmfulness of working conditions was carried out using instrumental measurements of harmful factors of the production environment, the severity and intensity of the labor process in accordance with current hygiene standards (14). During the measurements, modern equipment was used: GANK-4 gas analyzer, meteoscope-M, IR radiometer, Assistant-TOTAL + sound level meter, and TKA-Lux luxmeter). Ways to present and process data. The assessment of the adaptation potential (AP) of employees was carried out according to the method of R. M. Baevsky, according to which the level of adaptation potential is calculated using the formula (1, p. 73)

$$\Pi=0,0114CC+0,014CAД+0,008ДАД+0,014B+0,09M-(0,009P+0,27), \quad (1)$$

whence: HR – heart rate c for 1 min; the united states, and the SPB – blood pressure systolic and diastolic, mm pr. ct. C – age of the fly; the M – weight of bodies, kg; R – height, sm.

AP up to 2.59 points, is estimated as satisfactory adaptation; from 2.60 to 3.09 points, indicates the strain of adaptation mechanisms; 3.10-3.49 points – not satisfactory adaptation; 3.50 points and higher-failure of adaptation mechanisms (4, p. 126). Statistical processing of the research results was carried out using Microsoft spreadsheets and the Statistica 10 program. Ethical principle. For conducting research, based on article 181 Of the code of the Republic of Kazakhstan dated 18.09.2009. No. 193-IV «About health of nation and healthcare system», methods, physiological and biological research, a written informed consent form and other documents, approved by the Protocol decision of the meeting of the Commission on ethics of the state enterprise «MIIT MLSP» of February 4, 2019 No. 1, with participants in studies conducted by the procedure of obtaining written informed consent for participation in research.

Literature review

As you know, the international labor organization (ILO) advocates safe and healthy work as the only way to increase labor productivity, which means that the main priority in labor activity is the preservation of human life and health. This requires targeted and regular work to prevent occupational injuries and occupational diseases at each enterprise (5, p. 58). According to the literature (6, p. 97; 8, p. 22; 18, p. 346-349) the most important place in the formation of human health belongs to working conditions, since human resources are the basis of the enterprise, determine its competitiveness, and which depends on whether the company's management pays attention to the process of adaptation capabilities of the employees' body. Exposure to unfavorable working conditions can cause fatigue in the employee, which, accumulating, leads to occupational disease. In particular, under the influence of harmful and dangerous elements of the production environment, such as increased noise, dust, gas, the presence of various types of radiation, lead to an increase in muscle, mental and neuro-emotional load, worsen the indicators of the physiological functions of the employee and reduce his performance and production indicators by the end of the working day (5, p.58; 12, p. 122-124). The theory of workers' adaptation problems has been enriched by scientific research of many authors (11, p. 182; 13, p.465), which studied the nature, factors and types of adaptation potential. And as a result, the assessment of indicators of the adaptive potential of the body of employees can be the basis for the development of health and prevention measures of occupational risk.

RESEARCH RESULT

A comparative analysis of the number of industrial injuries by sector of the Republic's economy in 2019 showed (Fig. 1) that the highest rates of industrial injuries were registered in manufacturing (25%), mining (20%), construction (9%), and healthcare (9%). At the same time, the manufacturing and mining industries have a dominant number of cases of occupational diseases, equal to 39% and 54%, respectively. In 2019, these industries account for more than 45% of all accidents, including 93% of cases of occupational diseases.

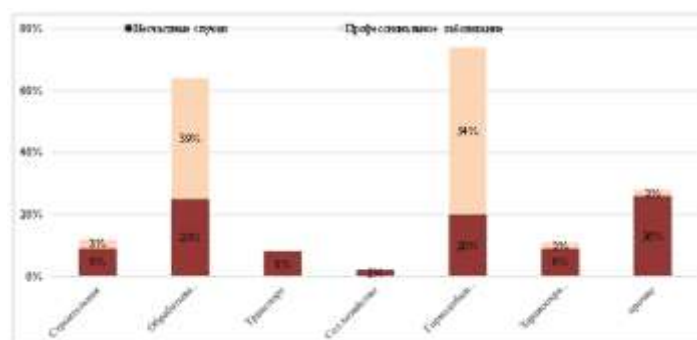


Figure 1: Ratio of the number of injured in accidents at work, including cases of occupational diseases by industry in 2019, %

In the field of injury prevention, it is important to analyze the causes of occupational accidents in order to justify preventive measures to prevent accidents at work with more severe consequences. Note that most accidents occur due to gross negligence of the victim (more than 60% of all cases), i.e. these are cases where the victim himself or the human factor is the culprit, due to the fact that the employee in the labor process allows incorrect (inaccurate, erroneous, untimely) actions, omission of necessary technological operations, reckless actions, etc., creating a dangerous situation. Dangerous actions of the employee may result from a decrease in the adaptive

potential, deterioration of the functional state of the employee due to the negative impact of factors of the production environment and the labor process.

In order to identify the dependence of the functional state of working conditions, was evaluated the adaptive capacity of employees of 20 companies, including the construction industry (3) agriculture (5), transport sector (3), manufacturing (8), mining (1), the total number of employees amounted to 269 people (table 1).

The analysis showed that a significant number of employees at enterprises are exposed to the harmful effects of factors of the production environment and the labor process. Unsatisfactory adaptation or its failure is observed in 15.8% of employees, while agricultural enterprises dominate, whose employees are more exposed to harmful production factors, in particular, 7% have a failure of adaptation. About half of the surveyed employees have a satisfactory level of adaptation, the variable range of their specific weight is 36.7%-55% (Fig. 2).

Table 1: Results of evaluation of the adaptive capacity of the investigated enterprise employees by industry

Name of the industry	Number of enterprise,.	Number of employees.	Adaptive potential, %			
			satisfactory	tension of mechanisms	unsatisfactory	disruption
constructive	3	33	12 (36,7%)	13 (39,3%)	8 (24%)	-
Manufacturing industry	8	122	67 (55%)	45 (37%)	7 (5,6%)	3 (2,4%)
Transport and warehousing	3	40	17 (42,5%)	16 (40%)	6 (15%)	1 (2,5%)
Agricultural industry	5	81	40 (49%)	20 (26%)	15 (18%)	6 (7%)
Mining industry	1	20	10 (50%)	9 (45%)	1 (5%)	-
TOTAL	20	296	146 (49,5%)	103 (34,7%)	36 (12,2%)	10 (3,6%)

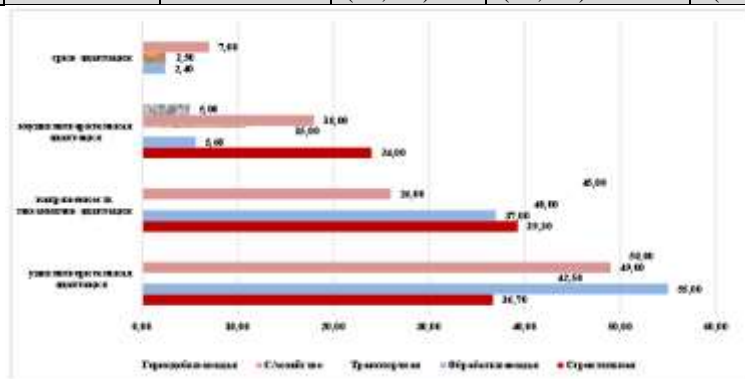


Figure 2: Grouping the proportion of workers in the degree of adaptation in the sectors of economy, %

In the construction industry, the total number of employees studied was 33 people of 22 different professions, of which 12 employees were found to have a satisfactory adaptation to working conditions, which is 36.7% of the total number of employees. The strain on adaptation mechanisms is observed in 13 employees, i.e. in percentage terms in 39.3% of the surveyed employees. At the same time, 24% or 8 of the surveyed employees have unsatisfactory adaptation due to harmful factors of the production environment. In particular, the harmful effects on the welder due to the presence in the air of welding fumes in combination with gas components (ozone, nitrogen oxides, carbon), UV radiation, and physical overload; Mason has a harmful effect high gas content and dust content of air of working zone (cement dust, ferromagnetic, aerosol iron ore and polymetallic concentrates), chemical factors, physical stress; carpenter characterized the harmful effects of dusty air, thermal effects and physical overload; electrical fitter and locksmith have harmful effects of noise and vibration, as well as physical overload.

In the manufacturing industry, the total number of employees studied was 122 employees of 66 different professions, of which 67 employees (55%) have a satisfactory adaptation, 45 employees (37%) have a lack of adaptation mechanisms, and 7 employees (5.6%) have an unsatisfactory adaptation. Professions that have unsatisfactory adaptation include: dairy equipment washer, dairy product packer, electrician, production shop operators (3 employees) and a worker of a crushing and sorting plant. Adaptation failure was detected in 3 employees (2.4%) of the following professions: plumber, shop foreman and concrete worker. Violation of adaptation in the body of workers is caused by harmful factors, the main of which are dust, vibration, noise, chemical factors, while the operator of the production shop is also affected by electromagnetic radiation, the intensity of the labor process (9, p. 635).

In the transport sector, the total number of investigated employees amounted to 40 employees of 26 different professions, of which satisfactory adaptation has 17 employees (42.5 per cent), the stress adaptation mechanisms have 16 employees (40%), poor adaptation in 6 workers (15 %), of which the chief of transportation, search and rescue support operations, the master of aviation services, mechanic services fuel and lubricants, cleaning the aircraft, welder, mechanic. Unsatisfactory adaptation in the body of the above-mentioned workers is caused by dangerous harmful factors, the main of which are the toxicity of many petroleum products and their vapors, especially leaded gasoline. There is also an employee who has a breakdown in the body's adaptation, this is the head of the ground service, which is associated with the body's reaction to increased nervous and emotional stress (class 3.1 in terms of labor intensity).

In the agricultural sector, the total number of investigated workers made up 43 81 workers in various professions, of which satisfactory adaptation has 40 employees (49%), stress adaptation mechanisms have 20 employees (35%), poor adaptation 15 employees (19%), of which the welder, clerk, machine operators, Turner, plumber, handymen, etc. Violation of adaptive mechanisms in the body of employees of the above-mentioned professions, occurred under the influence of significant physical overload. Failure of adaptation was found in 6 employees (7%), such professions as machine operator (3 people), mechanic and milkmaid (2 people). These professions are characterized by significant physical overload, including dynamic load, weight of the load and its movement, working posture. Also, the workplace may be adversely affected by chemical factors, including mixtures of hydrocarbons (gasoline, kerosene, fuel oil, oil) (10, p. 200).

In the mining industry, the total number of employees studied was 20 employees of 9 different professions, of which 10 employees (50%) have a satisfactory adaptation, 9 employees (45%) have a strain on the adaptation mechanisms, and 1 employee (5%) - a loader driver-has an unsatisfactory adaptation, which may be caused by exposure to noise and vibration loads, as well as temperature negative effects and the severity of work.

DISCUSSION OF RESULTS

Assessment of the adaptive capacity of 296 employees, 20 enterprises depending on working conditions showed that the stress mechanisms of the functioning of body systems has led to a decrease in physical performance, to exhaust the reserve capacity of the organism to breakdown, evident in the background of harmful and dangerous factors of production environment and thus a high degree of professional risk. The adaptive potential of 296 surveyed employees (166 professions, age 31-70 years) is evaluated satisfactorily in most of them (43%), however, unsatisfactory adaptation is noted in 15%, and adaptation failure in 5% of employees. The failure of adaptation mechanisms was found in employees of 10 professions, mainly in the manufacturing industry and agriculture. At the same time, most often in the risk zone of negative impact of harmful production factors that lead to a decrease in adaptive potential, such professions as electric and gas welder, washer (aircraft, dairy equipment), electrician, mechanic, master (workshops, services) can be noted. The above-mentioned employees are under the influence of a complex of factors: welding aerosols combined with gas components, toxicity of petroleum products and their vapors, electric and magnetic fields, increased dust in the work area containing silicon dioxide. These employees need targeted health and prevention measures to improve the protective properties of the body and strengthen its compensatory capabilities. Accordingly, for the purpose of prevention, annual periodic medical examinations, repeated instruction on labor safety, training and testing of knowledge of the requirements of the Rules on labor protection in the operation of electrical installations, as well as unscheduled and targeted instruction on labor safety as necessary are required.

CONCLUSION

Harmful working conditions lead to deterioration of the functional state and depletion of adaptive reserves of the body of workers. In this regard, timely prevention measures are needed to preserve the ability of employees to work. This method can be used as an Express method for assessing the functional state of employees, identifying certain categories of employees who have pronounced body dysfunctions at the preliminary stage of periodic medical examination of employees of industrial enterprises of the Republic.

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