ISSN 1477-9315

JOURNAL OF ENVIRONMENTAL HEALTH RESEARCH

Journal of environmental health research. ISSN 1477-9315

The abbreviation of the journal title "**Journal of environmental health research**" is "**J. Environ. Health Res.**". It is the recommended abbreviation to be used for abstracting, indexing and referencing purposes and meets all criteria of the ISO 4 standard for abbreviating names of scientific journals.

Journal of Environmental Health Research is devoted to the rapid publication of research in environmental health, acting as a link between the diverse research communities and practitioners in environmental health. Published articles encompass original research papers, technical notes and review articles. JEHR publishes articles on all aspects of the interaction between the environment and human health. This interaction can broadly be divided into three areas: 1.The natural environment and health– health implications and monitoring of air, water and soil pollutants and pollution and health improvements and air, water and soil quality standards; 2.The built environment and health – occupational health and safety, exposure limits, monitoring and control of pollutants in the workplace, and standards of health; and 3.Communicable diseases – disease spread, control and prevention, food hygiene and control, and health aspects of rodents and insects.

Editorial board

Professor Chan Lu – Xiang Ya School of Public Health, Central South University, China
Dr. Kristina Mena - School of Public Health, the University of Texas Health Science Center at Houston, USA
Dr Pablo Orellano - National Scientific and Technical Research Council (CONICET) and National Technological University, Argentina
Abdumalik Djalilov Tashkent Pediatric Medical Institute
Dilfuza Turdieva Tashkent Pediatric Medical Institute
Nigora Alieva Tashkent Pediatric Medical Institute
Khursandoy Akramova Tashkent Pediatric Medical Institute
Ozimbay Otaxanovich Jabbarov Tashkent medical academy
Professor Susan Pinney – College of Medicine, University of Cincinnati, USA
Professor Grażyna Plaza –Institute for Ecology of Industrial Areas, Poland
Professor Andrew Povey – School of Health Sciences, University of Manchester, UK
Dr Jack Siemiatycki - University of Montreal, Canada
Dr. Baltabaev Ubaidulla Abduvakilovich Tashkent State Dental Institute
Dr. Asrankulova Diloram Bakhtiyarovna - doctor of medical sciences, associate professor. Andijan State Medical institute
Dr. KHudaynazarova Salomat Tashkent Pediatric Medical Institute, Hospital Pediatrics 2, Department of Folk Medicine. PhD
Dr. Rakhimov Oybek Umarovich Tashkent Pediatric Medical Institute
Dr. Jafarov Khasan Mirzakhidovich, Tashkent Pediatric Medical Institute
Dr. Sodikova Dilrabo Andijan state medical institute
Dr. Kutlikova Gusalhon Andijan state medical institute
DSc, Musashaykhov Khusanboy Tadjibaevich Andijan State Medical Institute
Raimkulova Narina Robertovna Tashkent Pediatric Medical Institute
Nasirova Feruza Jumabaevna Andijan State Medical Institute
Kudratova Dilnoza Sharifovna Tashkent State Dental Institute
Rasulova Khurshidakhon Abduboriyevna Tashkent Pediatric Medical Institute
Tursumetov Abdusattar Abdumalikovich, DSci, professor, Tashkent Pediatric Medical Institute
Omonova Umida Tulkinovna Doctor of Medical Sciences, Associate Professor of the Department of Neurology, Children's Neurology and Medical Genetics, Tashkent Pediatric Medical Institute

Manuscripts typed on our article template can be submitted through our website here. Alternatively, authors can send papers as an email attachment to editor@jehr-online.org

Journal of environmental health research.
ISSN 1477-9315 http://www.jehr-online.org/
36 Victoria Road London N59 7LB

Journal of environmental health research. Volume 1 Issue 3 2022
ISSN 1477-9315 http://www.jehr-online.org/
Universal impact factor 7.2

STATE OF THE CARDIOVASCULAR SYSTEM UNDER EXPOSURE TO HARMFUL RISK FACTORS IN MINING INDUSTRY WORKERS

Y.A.Abdiyeva, G.S.Agzamova
Tashkent Medical Academy

Currently, one of the most significant problems in professional pulmonology is the issue of improving the quality of early diagnosis of dust lung diseases, the development of which is associated with exposure to dust aerosols of varying degrees of fibrogenicity. A systematic approach to early diagnosis of dust lung diseases will contribute to timely diagnosis, and will also allow predicting the development and course of respiratory and hemodynamic disorders, and contribute to the timely treatment of complications such as chronic cor pulmonale.

The article provides an analysis of the data of foreign and domestic authors on the most common adverse occupational risk factors for the occurrence and condition of cardio-vascular system for workers in the mining industry. Exposure to the harmful dust factor increases the risk of hospitalization for not only respiratory but also cardiovascular diseases. However, the mechanisms of etiology, pathogenesis, features of the course of cardiovascular diseases in mining workers, a number of issues on this issue remain poorly understood. In this regard, a differentiated approach is needed to study working conditions in the mining industry, based on real production situations, using a wide range of medical and biological indicators of the health of workers, a probabilistic assessment of the negative consequences of the impact of working environment factors on the health of workers in this sector.

Keywords: mining industry, occupational diseases, cardiovascular system, endothelial dysfunction.

The causes of diseases of the cardiovascular system indicate a great influence of adverse environmental factors and working conditions in the workplace [9,11,27, 57]. The interaction and combination of these factors is especially negative . This is confirmed by the research data of Z.S. Teregulova et al ., who showed that noise at workplaces exceeds the permissible level by 31-34% above the norm, vibration - by 22.2%, dust - by 11.1%, which is a mutually aggravating factor (the so-called "triad" negative risk factors) and accelerates the occurrence of pathological conditions [34].

G.I. Korshunov et al . cite digital data from the State Committee of Statistics of the Russian Federation that miners aged 40-65 years with pneumoconiosis or vibration disease had cardiovascular pathology in 26.3% at the initial medical examination [25]. For comparison, data are given for the same age group of people who were not exposed to negative professional factors; they had cardiovascular diseases in 11.9%. This indicates that under the influence of harmful production factors, the risk of cardiovascular diseases more than doubles.

Epidemiological studies show that exposure to particulate matter in the mining industry is also a risk factor for cardiovascular disease. For example, recent studies have shown that long-term silica dust inhalation increases the risk of death not only from respiratory disease but also from cardiovascular disease, revealing an exposure-response relationship between cumulative silica dust exposure and cardiovascular mortality. diseases [26,48].

The most common in the structure of cardiovascular diseases among workers in the mining industry are coronary heart disease (CHD) and arterial hypertension (AH). There is evidence that recently these diseases tend to grow and rejuvenate [4,21,41]. AH, being one of the most common CVD diseases, in addition to being a separate disease, is one of the most significant risk factors for cardiovascular diseases, in particular, coronary artery disease. It has been proven that a significant increase in risk is observed, starting from the level of systolic blood pressure of about 140 mm Hg. [3,10,39,40].

M.K. Tashmukhamedova showed that the frequency and level of increase in blood pressure of workers in the mining industry depends on age and length of service under the influence of harmful production factors. A significant increase in cases of hypertension was most often observed in groups of people with more than 10 years of work experience and at an age of more than 50 years [32].

S.K. Karabalin et al . presented the results of the prevalence of hypertension in the population of miners of the Karaganda coal basin, working in underground conditions, which is 35.6% and significantly exceeds that among surface workers. The authors found that AH is diagnosed in underground miners already at the young age of 30–39 years, while it is observed among surface workers at the age of 40–49 years [23].

This trend is also indicated by A.S. Baidina et al . [7], N.V. Zaitseva et al . [20], especially when exposed to harmful factors of production, the most aggravating of them is dust pollution of the air at the workplace.

Currently, the role of industrial vibration as a chronic stressor leading to the development of maladjustment has been established , and is also a risk factor for the occurrence of cardiovascular diseases and, in particular, hypertension [22,27,60]. Various works indicate a high frequency of AH in patients with vibration disease (VD) [6,21,38,61]. But what influences vibration, especially with prolonged exposure, on the occurrence and development of AH is still unclear. There is also no answer to the question whether hypertension in this case is an “independent” disease or a syndrome of vibration exposure. Some authors found that “vibration is a starting impulse for early uncompensated activation of lipid peroxidation (LPO) with depression of the antioxidant system (AOS) in leukocytes and platelets, high severity of inflammation processes, hormonal and metabolic disorders” [16, 42-44]. It has been shown that as a result of these processes, endothelial dysfunction develops with impaired release and utilization of nitric oxide and activation of the production of vasoconstrictor factors [2,14,20,29]. The same mechanisms play a certain role in the development of AH, which makes it extremely important to study AH in workers exposed to vibration for a long time [13,17]. Damage to the vascular endothelium in HB, aggravated by the presence of hypertension, is a predictor of hemocirculatory disorders that lead to severe trophic disorders, which determines the severity of the course, progression of the disease, and loss of professional ability to work [8,19,30]. A direct damaging effect of vibration on the vascular intima is assumed [21,44,66].

HE. Gerasimenko, V.A. Drobyshev, S.G. Abramovich [15], when studying endothelial dysfunction in patients with HF in combination with AH, revealed an increased content of cellular endothelial markers - TGF-β1 - in 1.8, PDGF-BB - in 1.5, VEGF - in 4.0, fibronectin - by 1.8, thrombospondin and thrombomodulin - by 2.0 and 1.4 times, respectively ($p<0.05$), which are predictors of cardiovascular risk.

R.A. Baraeva pointed out that the combination of vibration disease in AH, regardless of the type of vibration, there was a pronounced thickening of the intima-media complex, which indicates that remodeling of the vascular wall is developing [8].

Thus, prolonged vibration exposure increases the severity of vascular disorders that occur in the pathogenesis of hypertension, leading to the occurrence GB, the development of coronary artery disease, the frequent development of painless myocardial ischemia and the formation of small and large foci of myocardial infarction without a typical clinical picture.

O.Yu. Korotenko reported that in coal mine workers in Kuzbass, the wall thickness and mass index of the left ventricular myocardium were significantly higher in people with hypertension, and the longitudinal deformation of the left ventricle was significantly less, which is probably influenced by a complex of harmful occupational factors [24].

S.V. Tretyakov noted an increase in the longitudinal systolic function of the right ventricle against the background of a deterioration in its global diastolic function in workers exposed to industrial vibrations and suffering from hypertension [35].

Great importance in the occurrence of hypertension is given to psycho-emotional factors and depressive states. Thus, many authors emphasize that one of the frequent factors in the etiology of hypertension in modern society is considered to be professional stress or work stress arising from an imbalance between the requirements of work and control over work [5,72,75].

In particular, in a recent study by Y. Taouk et al ., based on a meta-analysis of 45 cohort studies, found an association between stress , high workload and morbidity and a 50% risk of death from CHD [79].

Some studies show that occupational noise has an impact on an increased risk of hypertension, coronary artery disease and stroke [50,81]. Yes , L. R. , Teixeira , F. _ Pega , a . M. _ Dzhambov et al . a relationship has been proven between exposure to occupational noise in the workplace (≥85 dBA) and the occurrence and its impact on the prevalence, morbidity and mortality of coronary artery disease, stroke and hypertension [80].

Several studies have shown that living in a cold climate or cooling the body increases CVD mortality [18,44,54,77]. The underlying mechanisms between low temperatures and mortality are not entirely clear. It is hypothesized that cold stress activates the sympathetic nervous system and the endocrine system and can cause cardiovascular stress due to increased blood pressure, blood viscosity and vasoconstriction [1,45,78].

M. _ Kivimäki , I. _ _ _ Kawachi found in vitro that exposure to cold is associated with increased blood pressure and changes in heart rate, but the effects depend on the type of cooling, the part of the body being cooled, and individual factors [61]. Working in extreme cold environments, such as in cold stores, is associated with hypertension. Work in a hot climate has a similar effect on the cardiovascular system, although research in this area is not enough [20,25,55].

Many studies confirm the high incidence of CHD (about 19%) among miners of the most working age (35-40 years). At the same time, work experience in this industry is 10 years or more. This figure is five times higher than the incidence of coronary artery disease among workers not employed in the mining industry. Moreover, in workers of mining enterprises, the authors showed a significant prevalence of atypical and painless forms of the disease. An increase in the incidence of coronary artery disease can be traced with the aging of workers and is associated with the length of work experience, which is associated with cases of angina pectoris and myocardial infarction [33,37].

M.K. Tashmukhamedova , when analyzing the prevalence of individual forms of coronary artery disease, indicated the occurrence of angina pectoris among the examined workers in the range from 2.5% to 7.8%. The author also confirmed that the frequency of coronary artery disease increases with age. Thus, among the examined persons aged 40-49 years, IHD occurred in 4.7-8.8% of cases, and among those over 50 years old - in 15.8-23.5% [32].

Studies of mortality and air pollution have also shown their influence on the risk of coronary artery disease. The mechanisms are not well understood, but it has been suggested that “particle air pollution induces a low-grade pulmonary inflammatory response and subsequent release of pro- inflammatory cytokines. This can lead to increased blood clotting, causing cardiovascular events in susceptible subjects" [36,74,82] . Due to long-term exposure to coal dust, miners usually develop lipid disorders and are susceptible to CVD [37,52,59,62]. Aldehydes such as acrolein are ubiquitous pollutants found in car exhaust, cigarettes, wood and coal smoke. Oral exposure to acrolein can induce or exacerbate dyslipidemia , as well as elevated plasma cholesterol and triglyceride levels, which increase the risk of CVD [48,49].

There are data in the literature on changes in heart rate variability associated with atmospheric air pollution with particulate matter [11,73]. Acute exposure to particulate air pollution has also been shown to increase the risk of ST segment depression in patients with CAD, as well as increase emissions from pacemakers [83] .

In workers who are heavily exposed to inorganic dust during their work shift, the concentration of interleukin-6 (IL-6) and fibrinogen in the blood increases. IL-6 is released from the bronchial mucosa and stimulates the production of fibrinogen in the liver. There is also an association between respiratory symptoms of CAD, further supporting the link between airway inflammation and CAD [56].

Inflammation can also contribute to increased levels of pulse wave velocity . For example Y. Saijo et al . reported a significant progressive increase in pulse wave velocity with highly sensitive levels of C-reactive protein in men after controlling for traditional CVD risk factors such as age, body mass index, systolic BP, heart rate, smoking, history of hypertension, hyperlipidemia , and diabetes [65 .76].

N. Andoh et al . also determined that pulse wave velocity was significantly related to serum levels of the highly sensitive C-reactive protein [46]. Studies have shown that pulse wave velocity increases with age and with hypertension [53], increased heart rate [68,70,81], and diabetes [69]. Inhaled silica particles can initiate cardiovascular inflammation through direct exposure to small particles that penetrate the lung epithelium into the cardiovascular system [67], or through indirect effects mediated by an inflammatory response.

There are a few works that draw a parallel between increased systemic inflammation and pneumoconiosis. Yes, R. Zhai et al . reported that serum levels of cytokines such as IL-6 were associated with pneumoconiosis in a Chinese sample [87].

JS Lee et al . suggested that high serum IL-8 levels in Korean subjects were associated with pneumoconiosis, and serum tumor necrosis factor-α levels were associated with progression of pneumoconiosis at 1-year follow-up [64], but not at 3-year follow-up [63]. In addition, case studies of pneumoconiosis in China have identified associations between pneumoconiosis and genetic polymorphisms associated with inflammatory markers such as E- selectin [84,85] or inflammasome (nodular receptor protein 3) [58]. The authors suggest that long-term exposure to silica dust can trigger an inflammatory response and damage artery walls, leading to atherosclerosis and cardiovascular events. Although the hypothesis needs to be confirmed using large-scale prospective cohort studies.

Increased arterial stiffness is thought to increase the risk of CVD. However , pulse wave velocity only reflects the stiffness of medium and large arteries and closely correlates with carotid-femoral pulse wave velocity, which is the gold standard for assessing the stiffness of large arteries [71,86,87].

In a study of the impact of noise effects on the cardiovascular system, it was shown that continuous noise resulted in an increase in the risk of CHD mainly during the shortest follow-up period, when most subjects were still working, but in the presence of impulsive noise and the associated workload, an excess risk of CHD persisted long after the patients retired [12,31].

In a study by H. W. _ Davies et al ., on CHD risk and noise exposure, much higher relative risks were associated with length of service in miners [50].

It has been suggested that noise may have direct physiological stress responses through the hypothalamic-pituitary-adrenal axis with secretion of stress hormones followed by an increase in BP and heart rate, strong risk factors for CHD in the long term [51].

According to S. Morrell , R. Taylor , DA Lyle (1997) noise can cause complications, for example by causing arrhythmia - an example of short-term effects. Noise can also have adverse psychosocial effects such as sleep problems or stress-related behavioral changes such as drinking alcohol or smoking - all risk factors for CHD with short and long term effects.

Like noise exposure, shift work also entails adverse psychosocial effects such as lack of social support and possible imbalance between effort and reward at work, and shift work can also cause CHD due to behavioral and circadian rhythms/mechanisms associated with the disorder. sleep [44,83]. In their review , Boggild and Knutsson (1999) concluded that, in general, shift workers have a 40% increased risk of CHD.

In a later article on the working environment of Danish shift and day workers , Björ B., Burström L., Eriksson K. et al . [47] found that shift work is commonly associated with other work environment factors that have been shown to be associated with CHD, workplace noise exposure and exercise being a triad of factors.

In the vast majority of studies devoted to the practical issues of studying risk factors for cardiovascular disease, traditional risk factors are taken into account. However, as established by other studies, the development of cardiovascular diseases is greatly influenced by harmful factors of the working environment and the labor process. Most of the works recognize not an isolated, but a complex effect of adverse production factors of various nature. Some of them have been studied more, others less. One of the harmful production factors in the mining industry that accompanies the entire technological process is air pollution with various toxic substances and the occurrence of occupational pneumoconiosis, dust bronchitis, etc. However, as it turns out, even short-term exposure to dust and chemical air pollution increases the risk of hospitalization for not only respiratory, but also cardiovascular diseases.

However, information on the prevalence of diseases of the circulatory system among workers working in hazardous working conditions is scarce and is presented mainly by the results of cross-sectional studies. Despite numerous studies on the mechanisms of etiology, pathogenesis, and characteristics of the course of cardiovascular diseases in high-risk workers, a number of issues on this issue remain poorly understood. In the literature, the features of the course of coronary artery disease are not sufficiently presented, data on its structure, clinical forms, and the prognostic value of risk factors under the influence of industrial factors of a physical and toxic nature are not systematized.

In connection with the foregoing, the need for a differentiated study of the working conditions of miners, based on real production situations, is obvious. At the same time, it is necessary to use a wide range of biomedical indicators of the state of health, a probabilistic assessment of the negative consequences of exposure to risk factors in the working environment, categorization and structuring of occupational risk, and systematic risk management.

Literature

1. Agadzhanyan N.A., Notova S.V. Stress, physiological and ecological aspects of adaptation, ways of correction. Orenburg: IPK GOU OGU, 2009. - S. 18-57.

2. Ageenkova O.A., Purygina M.A., Milyagin V.A. Structural and functional changes in the heart and blood vessels in patients with arterial

hypertension and coronary heart disease // Modern problems of science and education. - 2013. - No. 5. - P. 292.

3. Alekseeva T.S. The effectiveness of lifestyle modification measures in the prevention of arterial hypertension in an organized population: Abstract of the thesis . dis . ... cand. honey. Sciences - Kemerovo, 2014. - 31 p.

4. Andrushchenko T.A. Diseases of the circulatory system in coal mine workers in Ukraine, their prevention using molecular genetic markers // Profession and health: mater. XII Vseros . Congress of the V All-Russian . congress of occupational pathologists . - M., 2013. - S. 73.

5. Antropova O.N. Occupational stress and the development of stress-induced hypertension // Cardiology. - 2009. - No. 6. - S. 27-30.

6. Babanov S.A., Baraeva R. Occupational lesions of the cardiovascular system // Vrach. - 2015. - No. 3. - S. 7-10.

7. Baydina A.S., Zaitseva N.V., Kostarev V.G., Ustinova O.Yu. Arterial hypertension and cardiovascular risk factors in workers of underground mining of ore minerals // Occupational Medicine and Industrial Ecology . - 2019. - No. 11. - P.945-949.

8. Baraeva R.A. Vasomotor function of the endothelium and the content of endothelin-1 in patients with vibration disease and in combination with arterial hypertension // Occupational Medicine and Industrial Ecology. - 2017. - No. 9. - P.19-20.

9. Bashkatova Yu.V., Provorova O.V., Gorbunov D.V., Buldin A.N. The state of the cardiovascular system in conditions of industrial noise // Northern region: science, education, culture. - 2015. - V.3, No. 2 (32). - S. 25-29.

10. Bondarev O.I., Bugaeva M.S. Pathogenetic aspects of the development of arterial hypertension in coal industry workers // Complex problems of cardiovascular diseases. - 2015. - No. 1. - S. 46-50.

11. Bukhtiyarov I.V., Chebotarev A.G. Problems of occupational medicine at mining enterprises in Siberia and the Far North // Mining Industry. - 2013. - No. 5 (110). - P.77-86.

12. Vasyutkina D.I. Occupational noise and its impact on the human body // Bulletin of the Belgorod State Technological University. V.G. Shukhov. - 2013. - No. 1. - S. 125-128.

13. Vlasenko V.V. The state of the hormonal system in case of vibration disease in combination with arterial hypertension in the immediate and long-term periods: Abstract of the thesis . dis . … cand. honey. Sciences. - Novosibirsk, 2005 - 36 p.

14. Vlasova S.P., Ilchenko M.Yu., Kazakova E.B. Endothelial dysfunction and arterial hypertension. - M.: Medicine, 2010. - S. 235-238.

15. Gerasimenko O.N., Drobyshev V.A., Abramovich S.G. Endothelial-hemostasiological predictors of cardiovascular risk in the comorbid course of vibration disease and arterial hypertension . Occupational Medicine and Industrial Ecology. - 2017. - No. 9. - P.46.

16. Gerasimenko O.N., Chachibaya Z.K. Features of the hemostasis system in arterial hypertension in combination with vibration disease depending on the type of vibration // Occupational Medicine and Industrial Ecology. - 2014. - No. 3. - S. 7-11.
17. Gorshkov A.Yu., Fedorovich A.A., Drapkina O.M. Endothelial dysfunction in arterial hypertension: cause or effect? // Cardiovascular therapy and prevention . - 2019. - V.18, No. 6. – P.62-68.
18. Dudarev A.A., Talykova L.V. Occupational morbidity and occupational injuries in Russia (with an emphasis on the regions of the Far North, 1980–2010) // Biosphere. - 2012. - V.4, No. 3. - S. 343-363.
19. Zabolotnikova O.D. , Naugolnykh S.G., Zabolotnikova D.A. Endothelial dysfunction in vibration disease // Improvement of occupational care in modern conditions: mater. all - Russian scientific - practical . conf . with intl . participation, Shakhty, September 14-16, 2016 - Rostov n / D : Publishing House of the Science and Education Fund, 2016. - P.87-89.
20. Zaitseva N.V., Nosov A.E., Ivashova Yu.A., Baidina A.S., Kostarev V.G. Endothelial dysfunction in workers in the underground mining of chromium ores // Occupational Medicine and Industrial Ecology. - 2019. - V.59, No. 11. - P.914-919.
21. Izmerov N.F., Bukhtiyarov I.V., Ermakova M.A., Shpagina L.A. Features of the hemostasis system and vascular endothelial growth factor in arterial hypertension under conditions of high occupational risk // Occupational Medicine and Industrial Ecology. - 2014. - No. 3. - S. 1-6.
22. Indukaeva E.V., Makarov S.A., Ogarkov M.Yu. Medico-social risk factors for the development of arterial hypertension in coal mine workers // Systemic hypertension. - 2015. - V. 12, No. 1. - S. 47-51.
23. Karabalin S.K., Karabaeva R.Zh., Mazhitov T.M. Occupational conditionality of arterial hypertension in miners // Bulletin of the VSNC SO RAMS. - 2009. - No. 1 (65). - P.118-121.
24. Korotenko O.Yu. Evaluation of left ventricular deformity in coal industry workers depending on the presence of arterial hypertension. Cardiology of the 21st century: alliances and potential: Mater. Second Vseros . scientific - educate . forum with international participation; Topical issues of experimental and clinical cardiology: seminar for young scientists; Actual problems of pediatric cardiology and cardiac surgery: X All-Russian . school-seminar; Clinical electrophysiology and interventional arrhythmology : XII scientific -practical . conf . with intl . participation / Ed. A.A. Boshchenko . - Tomsk: Research Institute of Cardiology, Tomsk NIMC, 2021. - P.227.
25. Korshunov G.I., Cherkay Z.N., Mukhina N.V., Gridina E.B., Skudarnov S.M. Occupational diseases of workers in the mining industry // Mining Information and Analytical Bulletin. - 2012. - No. 2-5. - P.5-10.
26. Kulkybaev G.A. Modern problems of occupational pathology // Occupational Medicine and Industrial Ecology. - 2006. - No. 4. - P.1-7.

27. Lukyanov M.M., Andreenko E.Yu., Okshina E.Yu. Comparative analysis of the age characteristics of patients with arterial hypertension and coronary heart disease, taking into account the factor of combined cardiovascular diseases (data from the requazaclinic register) // Preventive Medicine. - 2018. - V.21, No. 2-2. - P.15.

28. Maksimov S.A., Mikhailuts A.P., Artamonova G.V. Identification of occupational risk of arterial hypertension. Message _ 1. Elimination of the modifying influence of cardiovascular risk factors // Hygiene and Sanitation. - 2016. - V. 95, No. 3. - P. 262-266.

29. Melentiev A.V., Serebryakov P.V., Sukhova A.V., Lipatova L.V. Occupational vibration and heart rate variability // Health and environment: coll. mater. rep . scient.- pract . conf . with intl . participation. - M., 2017. - S. 152-154.

30. Osipova I.V., Antropova O.N., Glebov N.O. Endothelial function and vascular reactivity in hypertension at the workplace // Cardiovascular therapy and prevention. - 2008. - V.7, No. 1. - P.19-23.

31. Serebryakov P.V., Melentiev A.V., Rushkevich O.P. Occupational noise and vibration and their role in the regulation of heart rate // Occupational health and labor longevity: Sat. mater. intl . scient.- pract . conf . - M., 2018. - S. 151-153.

32. Tashmukhamedova M.K. Prevention of diseases of the cardiovascular system among workers in the mining industry // Cardiology of Uzbekistan. - 2020. - No. 3. - S. 46.

33. Telkova I.L. Occupational characteristics of work and cardiovascular diseases: the risk of development and problems of prevention. Clinical and epidemiological analysis // Siberian medical journal. - 2012. - V. 27, No. 1. - S.17-26.

34. Teregulova Z.S., Tairova E.I., Karimova L.K., Iskhakova D.R., Abdrakhmanova B.R. Features of the formation of occupational morbidity among workers of mining enterprises // Bulletin of the All-Russian Scientific Center of the Siberian Branch of the Russian Academy of Medical Sciences. - 2006. - No. 3. - P.109-110.

35. Tretyakov S.V. The state of the longitudinal function of the right ventricle in persons with arterial hypertension exposed to vibrations at work // Occupational Medicine and Industrial Ecology. - 2011. - No. 1. - P.18-19.

36. Ustinova O.Yu., Vlasova E.M., Nosov A.E. Assessment of the risk of developing cardiovascular pathology in miners engaged in underground mining of chromium ore. Health risk analysis. - 2018. - No. 3. - P. 94-103.

37. Filimonov S.N., Panev N.I., Bourdein A.V., Korotenko O.Yu. Changes in the myocardium at rest and after an antiorthostatic test in combination of dust bronchitis with coronary heart disease and arterial hypertension. Problems of Health Management. - 2010. - No. 4. - P.84-88.

38. Chachibaya Z.K., Shpagina L.A., Kuznetsova G.V. Clinically significant disorders of hemostasis and peripheral blood flow in vibration disease in combination with arterial hypertension: optimization of treatment // Innovative technologies in occupational medicine and rehabilitation: mater. all - Russian scient.- pract . conf . with intl . participation. - Belokurikha, 2013. - P.166-168.

39. Chebotarev A.G., Prokhorov V.A. Occupational risks in the organizations of the mining and metallurgical complex of Russia // Metallurgist. - 2015. - No. 7. - P.112-116.
40. Chernyaeva M.S., Ostroumova O.D. Target levels of blood pressure in patients with arterial hypertension and coronary heart disease // Arterial hypertension . - 2020. - No. 26 (1). - P.15-26.
41. Chigisova A.N., Ogarkov M.Yu., Maksimov S.A. Socio-hygienic assessment of the risk of arterial hypertension in employees of coal mining enterprises. Health risk analysis. - 2017. - No. 3. - P.76-82.
42. Shlyapnikov D.M., Vlasova E.M., Shur P.Z. and other Features of the development of diseases of the circulatory system among employees of the enterprise for the extraction of potassium salts // Sanitary doctor. - 2014. - No. 10. - P.18-26.
43. Shpagina L.A. Comprehensive assessment of hemostasis and vascular remodeling in arterial hypertension and vibration disease in the dynamics of treatment // Profession and health: mater. 12th Vseros . congr .; All-Russian Congress of Occupational Pathologists , 5th. - M., 2013. - S.121-123.
44. Shpagina L.A., Chachibaya Z.K. Treatment of vascular and hemostatic disorders in arterial hypertension in combination with vibration disease // Medicine and education in Siberia. - 2013. - No. 3. - P.1-7.
45. Analitis A. et al. Effects of cold weather on mortality: results from 15 European cities within the PHEWE project // Am. J. epidemiol . – 2008 . – Vol. 168, No. 12. - P.1397-1408.
46. Andoh N., Minami J., Ishimitsu T., Ohrui M., Matsuoka H. Relationship between markers of inflammation and brachial-ankle pulse wave velocity in Japanese men // Int. Heart J. – 2006. - N47. – P.409-420.
47. Björ B., Burström L., Eriksson K. et al. Mortality from myocardial infarction in relation to exposure to vibration and dust among a cohort of iron-ore miners in Sweden // Occup. Environ Med. – 2010. – Vol.67, N3. – P.154-8.
48. Chen W., Liu Y., Wang H., Eva H., Sun Y., Su L. Long-term exposure to silica dust and risk of total and cause-specific mortality in Chinese workers: a cohort study // PLoS Med. – 2012. - N9. - e1001206.
49. Conklin D.J., Barski O.A., Lesgards J.F., Juvan P., Rezen T., Rozman D., Prough R.A., Vladykovskaya E., Liu S., Srivastava S., Bhatnagar A. Acrolein consumption induces systemic dyslipidemia and lipoprotein modification // Toxicol Appl Pharmacol. – 2010. - N243. –P.1-12.
50. Davies H.W., Teschke K., Kennedy S.M. et al. Occupational exposure to noise and mortality from acute myocardial infarction // Epidemiology. – 2005. -N16. – P.25-32.
51. Dzhambov A.M., Dimitrova D.D. Occupational noise and ischemic heart disease: a systematic review // Noise Health. – 2016. - Vol.18, N83. – P.167-177.
52. Eriksson H.P. et al. Longitudinal study of occupational noise exposure and joint effects with job strain and risk for coronary heart disease and stroke in Swedish men // BMJ open. – 2018. - Vol.8, N4. - e019160.

53. Fomenko D.V., Gorokhova L.G., Panev N.I., Kazitskaia A.S., Bondarev O.I. Clinical and experimental studies of metabolic response to chronic exposure to coal dust // Med. Tr. Prom. Ekol. – 2011. - N2. – P.15-21.

54. Fujiwara Y., Chaves P., Takahashi R., Amano H., Kumagai S., Fujita K. Relationships between brachial-ankle pulse wave velocity and conventional atherosclerotic risk factors in community-dwelling people // Prev. Med. – 2004. - N39. – P.1135-1142.

55. Gasparrini A. et al. Mortality risk attributable to high and low ambient temperature: a multicountry observational study // Lancet. – 2015. - Vol.386, N9991. – P.369-375.

56. Hilt B., Qvenild T., Holme J. *et al*. Increase in interleukin-6 and fibrinogen after exposure to dust in tunnel construction workers // Occup. Environ. Med. – 2002. - N59. – P.9-12.

57. Hwang W.J., Hong O. Work-related cardiovascular disease risk factors using a socioecological approach: implications for practice and research // Eur. J. Cardiovasc. Nurs. – 2012. - Vol.11, N1. – P.114-126.

58. Jermendy G., Nádas J., Hegyi I., Vasas I., Hidvégi T. Assessment of cardiometabolic risk among shift workers in Hungary // Health and Quality of Life Outcomes. – 2012. - Vol.10. – P.18.

59. Ji X., Hou Z., Wang T., Jin K., Fan J., Luo C. et al. Polymorphisms in inflammasome genes and risk of coal workers' pneumoconiosis in a Chinese population // PLoS ONE. – 2012. - N7. - e47949.

60. Kablak-Ziembicka A. et al. Carotid intima-media thickness, hs-CRP and OHO-a are independently associated with cardiovascular event risk in patients with atherosclerotic occlusive disease // Atherosclerosis. - 2011. - Vol.214, № 1. -P.185-190.

61. Kivimäki M., Kawachi I. Work Stress as a Risk Factor for Cardiovascular Disease // Curr. Cardiol. Rep. – 2015. - Vol.17, №9. – P.630.

62. Landen D.D., Wassell J.T., McWilliams L., Patel A. Coal dust exposure and mortality from ischemic heart disease among a cohort of U.S. coal miners // Am. J. Ind. Med. – 2011. - N54. – P.727-733.

63. Lee J.S., Shin J.H., Lee K.M., Hwang J.H., Baek J.E., Kim J.H., Choi B.S. Serum levels of TGF-beta1 and MCP-1 as biomarkers for progressive coal workers' pneumoconiosis in retired coal workers: a three-year follow-up study // Ind. Health. – 2014. - N52. – P.129-136.

64. Lee J.S., Shin J.H., Lee J.O., Kim J.H., Lee K.M., Choi B.S. et al. Serum Levels of Interleukin-8 and Tumor Necrosis Factor-alpha in Coal Workers' Pneumoconiosis: One-year Follow-up Study // Saf. Health. Work. – 2010. - N1. – P.69-79.

65. Mawaw P.M., Yav T., Mukuku O. et al. Increased prevalence of obesity, diabetes mellitus and hypertension with associated risk factors in a mine-based workforce, Democratic Republic of Congo // Pan. Afr. Med. J. – 2019. - N34. – P.135.

66. Miyano I., Nishinaga M., Takata J., Shmizu Y., Okumiya K., Matsubayashi K. et al. Association between brachial-ankle pulse wave velocity and 3-year mortality in community-dwelling older adults // Hypertens. Res. – 2010. - N33. – P.678-682.

67. Nawrot T.S., Alfaro-Moreno E., Nemery B. Update in occupational and environmental respiratory disease 2007 // Am. J. Respir. Crit. Care Med. – 2008. - N177. – P.96-700.

68. Nemmar A., Hoet P.H., Vanquickenborne B., Dindale D., Thomeer M., Hoylaerts M.F. et al. Passage of inhaled particles into the blood circulation in humans // Circulation. – 2002. - N105. – P.411-414.

69. Ninomiya T., Kojima I., Doi Y., Fukuhara Y., Hata J., Kitazono T. et al. Brachial-ankle pulse wave velocity predicts the development of cardiovascular disease in a general Japanese population: the Hisayama Study // J. Hypertens . – 2013. - N 31. – P. 477–483.

70. Ohnishi H., Saitoh S., Takagi S., Ohata J., Isobe T., Kikuchi Y. et al. Pulse wave velocity as an indicator of atherosclerosis in impaired fasting glucose: the Tanno and Sobetsu study // Diabetes Care. – 2003. - N26. – P.437-440.

71. Park K.H., Park W.J., Kim M.K., Jung J.H., Choi H.S., Cho J.R. et al. Noninvasive brachial-ankle pulse wave velocity in hypertensive patients with left ventricular hypertrophy // Am. J. Hypertens. – 2010. - N23. – P.269-274.

72. Pettersson H., Olsson D., Järvholm B. Occupational exposure to noise and cold environment and the risk of death due to myocardial infarction and stroke // Int. Arch. Occup. Environ Health. – 2020. – Vol.93, N5. – P.571-575.

73. Rauschenbach C., Krumm S., Thielgen M., Hertel G. Age and work-related stress: A review and meta-analysis // J. Manag. Psychol. – 2013. - Vol. 28, № 7/8. – P.781-804.

74. Riediker M., Cascio W.E, Griggs T.R. et al. Particulate matter exposure in cars is associated with cardiovascular effects in healthy young men // Am. J. Respir. Crit. Care Med. – 2004. - N169. – P.934-940.

75. Rosenthal T., Alter A. Occupational stress and hypertension // J. Am. Soc. Hypertens. – 2012. – Vol.6, N1. – P.2-22.

76. Saijo Y., Utsugi M., Yoshioka E., Horikawa N., Sato T., Gong Y. Relationships of C-reactive protein, uric acid, and glomerular filtration rate to arterial stiffness in Japanese subjects // J. Hum. Hypertens. – 2005. - N19. – P.907-913.

77. Skogstad M., Johannessen H. A., Tynes T., Mehlum I. S., Nordby K.-C., Lie A. Systematic review of the cardiovascular effects of occupational noise // Occupational Medicine. – 2016. – Vol.66, N1. – P.10-16.

78. Song X. et al. Impact of ambient temperature on morbidity and mortality: An overview of reviews // Sci Total Environ. – 2017. - N586. – P.241-254.

79. Taouk Y., Spittal M.J., LaMontagne A.D., Milner A.J. Psychosocial work stressors and risk of all-cause and coronary heart disease mortality: A systematic review and meta-analysis // Scand. Work Environ Health. – 2020. – Vol.46, N1. – P.19-31.

80. Teixeira L.R., Pega F., Dzhambov A.M. et al. The effect of occupational exposure to noise on ischaemic heart disease, stroke and hypertension: A systematic review and meta-analysis from the WHO/ILO Joint Estimates of the Work-Related Burden of Disease and Injury // Environ. Int. – 2021. - №154. – P.1063-87.

81. Theorell T., Hammarstrom A., Aronsson G. et al. A systematic review including meta-analysis of work environment and depressive symptoms // BMC Public Health. - 2015. - Vol. 15. – P.738.

82. Tomiyama H., Hashimoto H., Tanaka H., Matsumoto C., Odaira M., Yamada J. et al. Synergistic relationship between changes in the pulse wave velocity and changes in the heart rate in middle-aged Japanese adults: a prospective study // J. Hypertens. – 2010. - N28. – P.687-694.

83. Torén K., Bergdahl I.A., Nilsson T., Järvholm B. Occupational exposure to particulate air pollution and mortality due to ischaemic heart disease and cerebrovascular disease // Occup. Environ Med. – 2007. – Vol. 64, N8. – P.515-519.

84. Walker E.D., Brammer A., Cherniack M.G., Laden F., Cavallari J.M. Cardiovascular and stress responses to short-term noise exposures-A panel study in healthy males // Environ Res. – 2016. - N150. – P.391-397.

85. Wang T, Ji X, Luo C, Fan J, Hou Z, Chen M, et al. Polymorphisms in SELE gene and risk of coal workers' pneumoconiosis in Chinese: a case-control study // PLoS ONE. – 2013. - N8. - e73254.

86. Xiong Z., Zhu C., Zheng Z., Wang M., Wu Z., Chen L. et al. Relationship between arterial stiffness assessed by brachial-ankle pulse wave velocity and coronary artery disease severity assessed by the SYNTAX score // J. Atheroscler. Thromb. – 2012. - N19. – P.970-976.

87. Zhai R., Liu G., Ge X., Bao W., Wu C., Yang C. et al. Serum levels of tumor necrosis factor-alpha (TNF-alpha), interleukin 6 (IL-6), and their soluble receptors in coal workers' pneumoconiosis // Respir. Med. – 2002. - N96. – P.829-834.