



**WORKPLACE NUTRITION AMONG INDUSTRIAL WORKERS: IMPLICATIONS
FOR HEALTH AND SAFETY**

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ABSTRACT: This review article examines current data on the nutritional status of industrial workers, its imbalances, and their impact on occupational health and performance. It presents an analysis of common nutritional deficiencies and macro- and micronutrient imbalances characteristic of individuals engaged in physically strenuous and/or hazardous work. It has been established that the diet of most industrial workers does not meet physiological standards for protein, B vitamins, iron, calcium, and antioxidants. These deviations contribute to a decrease in the body's resistance to occupational hazards, the development of chronic fatigue, metabolic disorders, and increased susceptibility to occupational diseases. Particular attention is paid to the role of diet, caloric intake, and eating behavior in maintaining labor productivity. The conclusion substantiates the need for a systematic hygienic assessment of nutrition at enterprises, as well as the implementation of nutritional correction and prevention programs within the framework of occupational safety.

Key words: nutrition, workers, industry, occupational health, nutritional status, prevention, food hygiene.

**ПИТАНИЕ НА РАБОЧЕМ МЕСТЕ У ПРОМЫШЛЕННЫХ РАБОТНИКОВ:
ПОСЛЕДСТВИЯ ДЛЯ ЗДОРОВЬЯ И БЕЗОПАСНОСТИ**

АННОТАЦИЯ: В данной обзорной статье рассматриваются современные данные о состоянии питания промышленных рабочих, его дисбалансах и их влиянии на здоровье и работоспособность на рабочем месте. Представлен анализ распространенных дефицитов питательных веществ и дисбалансов макро- и микронутриентов, характерных для лиц, занятых физически тяжелой и/или опасной работой. Установлено, что рацион большинства промышленных рабочих не соответствует физиологическим стандартам по белкам, витаминам группы В, железу, кальцию и антиоксидантам. Эти отклонения способствуют снижению сопротивляемости организма к профессиональным опасностям, развитию хронической усталости, нарушений обмена веществ и повышению восприимчивости к профессиональным заболеваниям. Особое внимание уделяется роли питания, калорийности и пищевого поведения в поддержании производительности труда. В заключении обосновывается необходимость систематической гигиенической оценки питания на предприятиях, а также внедрения программ коррекции и профилактики нарушений питания в рамках охраны труда.

Ключевые слова: питание, работники, промышленность, охрана труда, пищевой статус, профилактика, гигиена пищевых продуктов.

RELEVANCE: A balanced and nutritious diet is one of the key factors determining the health and performance of the working population, especially in environments exposed to unfavorable occupational factors. Industrial workers, in particular, are exposed to daily physical, chemical, thermal, and psycho-emotional stress, requiring increased energy and nutrient intake. However,



numerous health studies indicate that the diet of this category of workers often fails to meet their physiological needs: deficiencies in protein, B vitamins, iron, and calcium, as well as insufficient caloric intake, are observed.

Poor nutrition in workers contributes to a decrease in the body's adaptive capacity, accelerated development of occupational diseases, deterioration of immune and endocrine function, increased chronic fatigue, and decreased productivity. Under conditions of high physical strain and exposure to harmful environmental factors, the need for a hygienic assessment and nutritional adjustments doubles.

Given that the occupational health and safety system in Uzbekistan and other countries is actively transforming toward preventative medicine, nutritional support for workers is becoming increasingly important. The development and implementation of nutrition programs tailored to specific industries is a crucial element in preventing health problems, extending longevity, and improving the economic efficiency of enterprises. Therefore, systematic study and scientific substantiation of the nutritional needs of industrial workers is a relevant and in-demand area of scientific research [1,3].

MATERIALS AND METHODS: This study was conducted in the format of a review scientific paper using an analytical method of summarizing data from domestic and foreign publications for the period 2010–2024. The sources used were scientific articles from the PubMed , Scopus , and Google databases.Scholar , eLibrary , as well as reports from the World Health Organization, the International Labor Organization, and the Ministry of Health of the Republic of Uzbekistan.

The primary inclusion criteria for the analysis were studies assessing the structure and quality of industrial workers' diets, their energy expenditure, and nutritional status, as well as studies examining the relationship between nutrition and occupational health. Particular attention was given to studies that utilized dietary hygiene assessment methods (24-hour questionnaires, nutritional value assessment tables, biochemical and anthropometric indicators), as well as analysis of macro- and micronutrient intake abnormalities.

Data related to workplace nutrition (canteen availability, rations, meal schedules), subjective factors (eating behavior, preferences, unhealthy habits), and their impact on workers' physiological well-being were also examined. The methodological framework included systematic and content analysis, a comparative-descriptive approach, and elements of a quantitative assessment of occupational health indicators based on nutritional status.

RESULTS AND DISCUSSION:

Rational nutrition is one of the most important exogenous factors that determine the body's homeostasis, immune stability, resistance to physical and psycho-emotional stress, as well as the prevention of a wide range of diseases .dataWorldwide According to the World Health Organization (WHO), up to 45% of cases of chronic pathology in the working population are associated with nutritional disorders, including vitamin and microelement deficiencies and macronutrient imbalances .

The physiological norms of consumption for an adult able-bodied man engaged in physical labor of moderate intensity are 3000–3500 kcal per day, with at least 100–120 g of protein, of which at



least 55% is of animal origin; 100–110 g of fat; and 400–500 g of carbohydrates. A deficiency of protein and vitamins B1, B2, B6, folic acid, and nicotinamide leads to disruption of energy metabolism, decreased tolerance to physical exertion, and a decrease in the synthesis of enzymatic systems, especially under loads associated with harmful working conditions.

Iron is a critical element for tissue oxygenation . Its deficiency leads to hypochromic anemia, which, according to research, is diagnosed in 15–20% of industrial workers, especially women and those working in hot environments. Magnesium and potassium are involved in the regulation of heart rate and muscle tone. A deficiency increases the risk of arrhythmias, seizures, and decreased muscle endurance.

Research by the Research Institute of Occupational Health shows that even a 10–15% deficiency of vitamin C in the diet of workers in heavy industries leads to an increase in the level of oxidative stress (based on malonic acid levels) Dialdehyde and catalase activity), which increases the risk of somatic and occupational diseases. Similarly, antioxidant deficiency and zinc deficiency are associated with impaired DNA repair and increased carcinogenesis, especially in workers with paints, varnishes, coal, and petrochemicals.

In some industries, significant fluid and electrolyte losses are observed, especially in hot and chemically contaminated workshops, requiring increased consumption of water, vitamins C and B, as well as sodium and potassium to prevent fluid and electrolyte imbalances. Adequate and balanced nutrition, taking into account the specifics of the production load, is an integral part of the prevention of occupational and general somatic diseases. It increases adaptive reserves, helps reduce the incidence of illness and the number of sick days, and directly impacts labor productivity and the economic efficiency of enterprises. Regular nutritional assessments and the development of programs to optimize employee nutrition are scientifically proven requirements within the framework of modern preventive medicine [4, 7].

Current scientific data obtained from comprehensive hygiene surveys of workers at industrial facilities in Russia, Uzbekistan, China, and the EU indicate persistent nutritional imbalances among a significant portion of the working population engaged in heavy physical labor and exposure to harmful occupational factors. According to research by the Russian Academy of Medical Sciences' Research Institute of Occupational Hygiene, 62% of workers at metallurgical and machine-building plants exhibited an energy deficit of 500 to 1,000 kcal/day compared to the physiological norm, leading to chronic fatigue, decreased muscle mass, and impaired carbohydrate metabolism. Furthermore, up to 48% of surveyed workers consumed less than 80 grams of protein per day, compared to the recommended 100–120 grams for men with moderate physical activity, and animal protein content often did not exceed 40%.

D, are common. For example , according to nutritional surveys of cable industry workers in Uzbekistan (2022), 71% had laboratory-confirmed hypovitaminosis B1 and B6, accompanied by neurological complaints, decreased attention, and drowsiness. Vitamin C deficiency, detected in 68% of workers, is manifested by decreased antioxidant protection and frequent acute respiratory infections. According to the WHO, vitamin D deficiency among indoor workers in winter amounts to up to 85%, leading to impaired phosphorus-calcium metabolism, muscle and joint pain, especially during night shifts and in the absence of access to natural light [1, 2].

Equally alarming are the data on iron, magnesium, zinc, and selenium deficiencies. According to monitoring by the National Center for Hygiene and Occupational Health, iron deficiency anemia occurs in 23% of women and 11% of men employed in electrical equipment manufacturing, due to poor iron absorption due to a lack of meat products in the diet and increased iron losses during stressful periods. Magnesium deficiency, observed in 30% of workers, leads to muscle spasms,



irritability, and insomnia, while zinc and selenium deficiencies weaken the immune system and reduce reproductive function [6].

Dietary habits are also disrupted: according to surveys, more than 60% of industrial workers skip breakfast at home, 45% limit themselves to carbohydrate snacks (tea with bread, pastries), and only eat a full meal in the evening. This leads to insulin imbalances, visceral fat accumulation, and an increased risk of metabolic syndrome and obesity. Furthermore, the diet of most workers is dominated by refined foods low in dietary fiber and vitamins—white bread, pasta, and potatoes—while less than 200 grams of fruits and vegetables are consumed per day, compared to the recommended daily intake of 400–500 grams.

According to reports from the International Labor Organization, such nutritional deficiencies increase the risk of occupational disability, reduce productivity by 20–30%, and increase morbidity by 1.5–2 times. This underscores the need to develop and implement hygienic standards for assessing and adjusting workers' nutrition, especially in harsh and hazardous industrial environments. Regular nutritional monitoring and dietary interventions should become an integral part of the occupational health and safety system [2, 3, 4].

Recent scientific research confirms that the eating behavior and diet of industrial workers are closely linked to the risk of metabolic disorders, cardiovascular diseases, gastroenteropathy, and occupational fatigue. According to research by the National Institute of Nutrition (Russia, 2021), more than 60% of industrial workers do not eat regularly, with 40% limiting themselves to two meals a day, which significantly increases the burden on the pancreas and contributes to the development of insulin resistance.

An analysis of the dietary habits of workers at hazardous workplaces revealed that 75% of employees consumed excess saturated fats and simple carbohydrates in their diets. Moreover, a dietary fiber deficiency (less than 15 grams per day, compared to the recommended intake of 25–30 grams) was recorded in over 80% of those surveyed, due to low consumption of vegetables, fruits, and whole grains. This leads to decreased intestinal motility, dysbiosis, and chronic constipation, especially in individuals with sedentary or static workloads.

Among night shift workers, according to the results of comparative epidemiological studies (Zhao et al., 2019; WHO, 2020) noted that obesity rates exceed 45%, and body mass index (BMI) is 2–3 kg/m² higher than in daytime workers. These workers are also twice as likely to have hypertension and elevated triglyceride levels. These changes are directly related to disrupted circadian rhythms of eating and high calorie consumption in the evening/nighttime.

A 2022 study conducted in Uzbekistan among workers at an electromechanical plant found that 58% of workers exhibited signs of evening overeating, accompanied by sleep disturbances, stomach heaviness, and indigestion. More than 30% of respondents admitted to replacing one meal with tea or sugary drinks, and 25% consumed energy drinks, which is associated with a long-term risk of developing hypertension and cardiac arrhythmias [4,5].

Furthermore, according to the European Agency for Safety and Health at Work (EU-OSHA), the availability of corporate canteens and access to balanced meals reduces sick leave by 15–20% and the average duration of temporary disability by 1.5 days per person per year. This underscores that interventions aimed at normalizing diet and nutritional quality are not only medically but also economically effective. Systemic disturbances in workers' eating behavior, coupled with inadequate education, a lack of adequate nutrition, and shift work patterns, create persistent preconditions for deteriorating health and require hygiene monitoring, organizational solutions, and preventative programs [6,7].



Improving the nutrition of industrial workers requires a comprehensive approach, including organizational, hygiene, and educational measures. First and foremost, access to hot, balanced meals should be ensured in the workplace through corporate cafeterias, with meals tailored to energy expenditure and the specific needs of the work process. Dietary adjustments are necessary, increasing protein, B vitamins, vitamin C, iron, and dietary fiber. The introduction of fortified foods is recommended, and if deficiencies are identified, fortified diets and nutritional support should be used.

At the same time, health education efforts should be conducted to develop workers' skills for healthy eating and mindful eating behavior. The development of nutrition standards and regulations for various professions and shift work patterns is essential. Regular nutritional status monitoring and nutrition-focused medical examinations should be part of a preventive health strategy for the working population.

CONCLUSIONS:

The conducted analysis of scientific sources showed that the nutrition of workers at industrial enterprises in most cases does not meet the physiological needs characteristic of conditions of physical and industrial stress. It was established stable deficiencies in protein, B vitamins, vitamin C, iron, magnesium, and dietary fiber, accompanied by poor dietary habits, reduced meal frequency, and a predominance of refined and unhealthy foods. This has a direct impact on performance, immune status, and the body's adaptive capacity, increasing the risk of developing chronic and occupationally related diseases.

Eating disorders are particularly prevalent among shift workers and night shift workers, who experience high rates of obesity, metabolic disorders, and gastrointestinal issues. A lack of health and hygiene education and limited opportunities for organized workplace meals further exacerbate the situation. Healthy eating should be considered an integral part of occupational health and safety. Nutritional prevention programs are essential, including the provision of hot, balanced meals, regular nutritional monitoring, and educational outreach to workers. This will reduce illness, increase productivity, and improve the overall quality of life of the working population.

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