IDENTIFICATION OF FACTORS LEADING TO OCCUPATIONAL DISEASES

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Abstract: Occupational diseases remain a significant challenge for industrial enterprises, agricultural organizations, construction companies, and other sectors involving exposure to hazardous and harmful working conditions. Their development is often associated with prolonged or repeated exposure to physical, chemical, biological, ergonomic, and psychosocial factors. Unlike acute occupational injuries, occupational diseases may develop gradually, making their early identification and prevention considerably more complicated. In many cases, employees do not recognize the relationship between their health problems and specific workplace exposures until the disease has progressed. This article examines the principal factors contributing to the development of occupational diseases and considers methodological approaches to their identification. Particular attention is given to workplace exposure assessment, the duration and intensity of harmful factors, individual susceptibility, working conditions, and the effectiveness of preventive measures. A systematic approach is proposed for identifying occupational disease risks by integrating hazard identification, exposure assessment, health surveillance, and preventive management. The study also develops a conceptual model for evaluating the combined influence of workplace factors on occupational health. The proposed approach can support the development of preventive strategies and improve occupational health management in industrial organizations.

Keywords: occupational diseases, occupational health, harmful working conditions, workplace hazards, chemical exposure, physical factors, ergonomic risks, psychosocial factors, risk assessment, preventive measures

Introduction

The protection of employees' health is one of the fundamental objectives of occupational safety and health management. Modern production processes involve various technological operations, equipment, materials, and working environments that may expose employees to factors capable of causing long-term adverse health effects. When such exposure continues over an extended period, it can contribute to the development of occupational diseases.

Occupational diseases differ from ordinary illnesses primarily because of their relationship with professional activities and workplace exposure. Their development may be associated with specific hazardous substances, excessive physical loads, unfavorable microclimatic conditions, biological agents, repetitive movements, and other occupational factors. In many situations, the disease develops gradually and may remain unnoticed during the initial stages.

One of the main difficulties in preventing occupational diseases is the complex nature of their causes. A particular health disorder may result from a single dominant occupational exposure or from the combined influence of several harmful factors. For example, employees working in industrial environments may simultaneously experience excessive noise, vibration, dust exposure, physical fatigue, and psychological stress. These factors may interact and increase the overall occupational health burden.

Another important problem is the insufficient identification of harmful workplace conditions. Some enterprises concentrate primarily on preventing accidents and injuries, while long-term

occupational exposure receives less systematic attention. However, the absence of visible incidents does not necessarily indicate that working conditions are safe.

The identification of occupational disease factors therefore requires a comprehensive approach that combines workplace inspections, instrumental measurements, occupational exposure records, medical examinations, and analysis of work processes.

The purpose of this study is to identify the principal factors leading to occupational diseases, examine their mechanisms of influence on human health, and develop a methodological approach for evaluating occupational health risks and improving preventive measures.

Materials and Methods

The research is based on a theoretical and analytical examination of occupational health principles, workplace hazard classification, and established approaches to occupational risk management.

The methodological foundation includes the analysis of international occupational health and safety guidance, comparison of different categories of harmful workplace factors, and systematization of the mechanisms through which occupational exposures may affect the human body.

The study considers the following methodological approaches:

Hazard identification: examination of production processes, technological equipment, materials, substances, and workplace conditions to identify potential sources of occupational diseases.

Exposure assessment: determination of the nature, intensity, frequency, and duration of employee contact with harmful factors.

Comparative analysis: examination of the differences between physical, chemical, biological, ergonomic, and psychosocial occupational hazards.

Medical and occupational analysis: consideration of health surveillance, medical examination results, occupational history, and possible relationships between workplace exposure and health disorders.

Risk-based assessment: evaluation of the probability and potential severity of adverse health consequences associated with identified occupational exposures.

The research is theoretical and methodological in nature. No experimental measurements, clinical investigations, or enterprise-specific statistical results are claimed. The proposed analytical framework is intended for practical adaptation and subsequent empirical validation.

Results

Physical factors are among the most widespread sources of occupational health risks in industrial production, construction, mining, transportation, and agricultural activities. Their influence depends on exposure intensity, duration, workplace organization, technical protection measures, and individual characteristics of employees.

Noise is one of the most significant physical occupational hazards. Continuous exposure to excessive noise can damage the auditory system and contribute to occupational hearing loss. The risk increases when employees work near industrial machinery, compressors, turbines, metal-processing equipment, and other noise-generating installations without sufficient protection.

Vibration is another important factor. Local vibration transmitted through hand-held tools may affect the vascular and nervous systems of the upper extremities. Whole-body vibration, commonly associated with vehicles, tractors, construction machinery, and industrial equipment, may contribute to musculoskeletal disorders, particularly when exposure is prolonged and accompanied by unfavorable working postures.

Unfavorable microclimatic conditions also influence occupational health. Excessive heat may cause dehydration, thermal stress, cardiovascular strain, and reduced physical performance.

Employees working in hot production facilities, greenhouses, foundries, and outdoor agricultural environments may experience considerable thermal loads. Low temperatures and cold working environments can increase the risk of cold-related disorders and aggravate certain musculoskeletal complaints.

Insufficient or excessive illumination may contribute to visual fatigue, headaches, and reduced concentration. Although these effects do not always represent occupational diseases themselves, they can worsen working conditions and increase the probability of occupational errors.

Radiation exposure requires particular attention in specialized industries. Ionizing radiation may cause serious health effects depending on absorbed dose and exposure conditions. Certain non-ionizing radiation sources, including ultraviolet and laser radiation, may also damage the eyes and skin when appropriate protective measures are absent.

Chemical factors and their influence on human health

Chemical hazards are particularly relevant in chemical production, mining, metallurgy, agriculture, construction, pharmaceutical manufacturing, and other industries involving hazardous substances.

Employees may be exposed to chemical agents through inhalation, skin contact, accidental ingestion, or other routes of occupational exposure. The health consequences depend on the chemical properties of the substance, its concentration, exposure duration, frequency, and the effectiveness of engineering and personal protective measures.

Industrial dust is one of the major causes of occupational respiratory diseases. Prolonged inhalation of respirable crystalline silica can lead to silicosis, while exposure to asbestos fibres may cause asbestosis and increase the risk of certain cancers. Coal and other mineral dusts may also contribute to serious respiratory disorders depending on their composition and exposure conditions.

Chemical vapours and gases represent another important category. Exposure to certain solvents may affect the nervous system, liver, kidneys, and other organs. Some metals and their compounds, including lead and mercury, can cause systemic toxic effects. Carbon monoxide exposure may interfere with oxygen transport in the body and cause acute poisoning under dangerous conditions.

Agricultural workers may encounter pesticides and other chemical products during preparation, mixing, application, equipment cleaning, and storage. Improper handling can result in skin contamination, inhalation exposure, and acute or chronic health effects depending on the active substance and exposure level.

The identification of chemical hazards should therefore include an inventory of substances, examination of safety data sheets, assessment of exposure routes, workplace air monitoring where necessary, and verification of engineering control measures.

Biological factors associated with occupational diseases

Biological hazards are common in healthcare, veterinary medicine, agriculture, food processing, waste management, laboratories, and other sectors involving contact with biological materials.

These hazards may include bacteria, viruses, fungi, parasites, biological toxins, and contaminated materials. Their effects depend on the characteristics of the biological agent, transmission route, exposure conditions, and the immune status of the exposed individual.

Healthcare employees may be exposed to infectious agents through direct contact with patients, contaminated instruments, biological fluids, and airborne particles. Agricultural workers may encounter microorganisms associated with animals, animal products, soil, organic dust, and contaminated water.

Certain biological exposures may lead to occupational infections, allergic reactions, respiratory disorders, or other adverse health effects. For example, exposure to mold and fungal spores in poorly ventilated agricultural storage facilities may contribute to respiratory and allergic conditions.

Effective prevention requires biological hazard identification, appropriate ventilation, hygiene procedures, cleaning and disinfection, safe handling of biological materials, vaccination where indicated, and suitable personal protective equipment.

Ergonomic factors and musculoskeletal disorders

Ergonomic hazards are associated with the mismatch between the physical and functional capabilities of employees and the requirements of their work activities.

One of the principal causes of work-related musculoskeletal disorders is excessive physical loading. Repeated lifting, carrying, pushing, pulling, and handling of heavy objects may place excessive demands on the musculoskeletal system.

Unfavorable working postures also contribute to occupational health problems. Prolonged bending, twisting, working with raised arms, and maintaining static positions can increase the mechanical load on muscles, joints, and spinal structures.

Repetitive movements represent another important risk factor. Employees performing similar movements over extended periods, particularly with insufficient recovery time, may develop disorders affecting the hands, wrists, shoulders, and other body regions.

In industrial production, the use of poorly designed workstations, inappropriate equipment dimensions, and insufficient opportunities to change working posture may intensify ergonomic risks.

The prevention of these problems requires workplace redesign, mechanical lifting devices, appropriate workstation dimensions, task rotation where suitable, sufficient recovery periods, and ergonomic training.

Psychosocial factors and occupational health

Psychosocial conditions are increasingly recognized as important elements of occupational health management. Although they may not produce the same immediate effects as chemical or physical hazards, prolonged exposure to unfavorable psychosocial conditions can negatively affect employees' physical and psychological well-being.

Excessive workload, long working hours, insufficient rest, unclear responsibilities, workplace harassment, poor managerial communication, and job insecurity may contribute to work-related stress.

Persistent stress can be associated with sleep disturbances, emotional exhaustion, reduced concentration, anxiety, and other health problems. It may also aggravate existing health conditions and influence employees' ability to perform tasks safely.

A particularly important issue is the relationship between psychosocial stress and other occupational hazards. An employee experiencing fatigue and psychological pressure may have reduced attention when working with machinery, handling chemicals, or performing tasks at height.

Therefore, psychosocial risk assessment should be integrated into the general occupational health management system rather than treated as a separate issue unrelated to production safety.

Combined influence of occupational hazards

In real production environments, employees are rarely exposed to only one harmful factor. Several physical, chemical, biological, ergonomic, and psychosocial exposures may occur simultaneously.

For example, a worker in a mining enterprise may experience noise, vibration, mineral dust, high physical workload, and unfavorable microclimatic conditions. An agricultural employee may

simultaneously encounter pesticide exposure, solar radiation, heat, repetitive physical movements, and long working hours.

The combined influence of these factors makes occupational health risk assessment more complicated. Evaluating each hazard separately may not fully represent the actual working conditions.

For this reason, the assessment process should consider the interaction between hazards, the duration of exposure, the characteristics of the work process, and the effectiveness of existing preventive measures.

Methodological approach to identifying occupational disease factors

Based on the analysis, an integrated methodological approach is proposed for identifying factors that may lead to occupational diseases.

The approach begins with an examination of the technological process and the identification of all operations performed by employees. Particular attention should be given to tasks involving hazardous substances, excessive physical loads, unfavorable environmental conditions, and repeated exposure.

The next stage involves identifying harmful factors and determining their potential routes of influence on the human body. This process should include workplace observations, equipment inspections, analysis of chemical inventories, and examination of existing safety documentation.

Following hazard identification, exposure assessment should be conducted. Depending on the nature of the hazard, this may involve measuring noise levels, vibration, temperature, illumination, airborne contaminants, or other relevant parameters. The assessment should use appropriate instruments and applicable national or international exposure criteria.

Occupational health surveillance provides an additional source of information. Medical examinations, occupational histories, and health monitoring can help identify possible relationships between working conditions and employee health. Medical conclusions must be made by qualified healthcare professionals.

The expression describes the structure of the assessment rather than a validated numerical calculation. It indicates that occupational disease risk cannot be determined solely by measuring the intensity of a harmful factor. Exposure duration, frequency, individual circumstances, and preventive measures must also be considered.

For practical application, the model may be developed into a quantitative assessment tool using exposure measurements, occupational health indicators, and validated weighting coefficients. Such coefficients should be established through empirical research rather than assigned arbitrarily.

Preventive measures for reducing occupational disease risks

The prevention of occupational diseases should begin with the elimination or reduction of harmful workplace exposures. The most effective approach is based on the hierarchy of controls, which prioritizes measures according to their ability to reduce risk.

Elimination of a hazardous process or substance is preferable whenever technically and economically feasible. If elimination is not possible, substitution with a less hazardous material or technology should be considered.

Engineering controls, including local exhaust ventilation, equipment enclosure, noise reduction systems, automated handling, and effective dust suppression, can significantly reduce employee exposure.

Administrative measures include work scheduling, limitation of exposure time where appropriate, task rotation, maintenance procedures, employee training, and workplace supervision.

Personal protective equipment is an important additional measure when exposure cannot be adequately controlled through other means. Respirators, protective gloves, hearing protection, safety clothing, and eye protection should be selected according to the specific hazard and applicable requirements.

Medical surveillance and occupational health monitoring are also essential. Periodic examinations can help identify early health changes and support timely preventive intervention. However, medical surveillance should complement, not replace, effective workplace hazard control.

Organizations should also maintain accurate records of occupational exposures, workplace measurements, health surveillance outcomes, and implemented preventive measures. Such information provides a foundation for evaluating the effectiveness of occupational health management.

Discussion

The findings indicate that occupational diseases are associated with a complex combination of workplace exposures and organizational conditions. Their development cannot always be attributed to a single harmful factor because employees may experience several exposures simultaneously and over different periods.

One of the main methodological challenges is distinguishing occupational exposure from other factors that may influence health. Individual medical history, non-occupational environmental exposure, lifestyle factors, and pre-existing health conditions may also be relevant. Therefore, establishing a causal relationship between a workplace factor and a particular disease requires professional medical assessment and appropriate exposure documentation.

Another important issue concerns the difference between hazard identification and disease diagnosis. Workplace inspections and instrumental measurements can identify harmful conditions and estimate exposure, but they cannot independently establish a clinical diagnosis. Medical examinations and professional evaluation are required to determine whether a health disorder meets the applicable criteria for recognition as an occupational disease.

The proposed conceptual model emphasizes the need to combine workplace and health-related information. This is particularly important for enterprises where employees are exposed to several harmful factors over extended periods.

The hierarchy of controls should remain the principal basis for prevention. Reliance exclusively on personal protective equipment or periodic medical examinations is insufficient if the original source of harmful exposure remains uncontrolled.

The practical value of the proposed approach lies in its potential application across different industries. In mining, priority may be given to dust, noise, vibration, and physical workload. In agriculture, chemical exposure, heat, biological hazards, and ergonomic conditions may require greater attention. In healthcare, biological agents, chemical disinfectants, ergonomic loading, and psychosocial stress may be particularly relevant.

Further research should examine the proposed model using workplace exposure measurements, employee occupational histories, medical surveillance indicators, and enterprise-specific data. Such research would make it possible to determine the relative importance of different factors and develop more precise occupational disease prevention strategies.

Conclusion

The identification of factors leading to occupational diseases is an essential element of occupational health and safety management. The development of such diseases is frequently associated with prolonged or repeated exposure to physical, chemical, biological, ergonomic, and psychosocial hazards.

The analysis demonstrates that the intensity of exposure alone is insufficient to characterize occupational disease risk. Exposure duration, frequency, individual susceptibility, working conditions, and the effectiveness of preventive measures must also be considered.

The proposed methodological approach integrates workplace hazard identification, exposure assessment, occupational health surveillance, and preventive management. Its conceptual model provides a framework for examining the combined influence of harmful factors and identifying priorities for occupational health intervention.

The practical implementation of this approach requires regular workplace assessments, reliable exposure measurements, appropriate medical surveillance, accurate occupational records, and systematic application of preventive controls.

The principal scientific contribution of the study is the development of an integrated conceptual framework for identifying occupational disease factors through the combined consideration of exposure characteristics, individual susceptibility, and preventive control effectiveness. The proposed framework can serve as a basis for further empirical research and the development of industry-specific occupational health assessment methods.

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