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Prevention of Occupational Allergic Diseases

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Summary

Objective: Occupational allergic diseases represent a distinct group of work-related illnesses caused by allergens in the workplace, which do not typically cause clinical symptoms in healthy individuals. The aim of this review was to summarize the occurrence, basic characteristics, risk factors and prevention of most common occupational diseases.

Design: Review article analyzes the available publications about different types of occupational allergies. Statistical data for Slovakia were used from National Centre of Health Information in Slovakia and from Eurostat for Europe.

Results: Occupational allergies are usually chronic conditions that are triggered or aggravated by work activities. They typically manifest within the first few months of starting a job, with worsening symptoms upon continued exposure to the allergen. Depending on the body location, common occupational allergic diseases include allergic contact dermatitis, allergic rhinitis, occupational bronchial asthma, and exogenous allergic alveolitis. Workplace allergens are most found in various industrial sectors (construction, printing, rubber industries, etc.), but also in food processing, healthcare, horticulture, hairdressing, and other fields.

Conclusion: Globally comes to increase in allergic diseases over recent decades. The rapid emergence of new occupational technologies rises the awareness in the category of work-related allergies and implementing effective prevention strategies. Prevention plays a substantial role in the management of professional allergies and includes the use of personal protective equipment, workplace preventive measures, and proper management of at-risk employees. In cases of suspected work-related allergies, early diagnosis, prompt and effective treatment, and allergen avoidance, including reassignment to a different position, are crucial.

Keywords occupational disease, occupational allergies, dermatoses, allergic rhinitis, bronchial asthma, alveolitis, prevention

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Introduction

An occupational disease is defined as a disease that develops in an employee while performing work or service-related tasks. It must be recognized by an appropriate healthcare facility specializing in occupational medicine.

Occupational allergic diseases form a specific subgroup of occupational diseases caused by allergens in the workplace that do not trigger clinical symptoms in healthy individuals. It is typically a chronic condition caused or aggravated by work activities. Occupational allergic diseases generally appear within the first few months of starting a job and worsen with continued exposure to the allergen. Many workplaces' hazards damage various organs also through non-allergic mechanisms (e.g., silicosis, pneumoconiosis, pulmonary asbestosis).

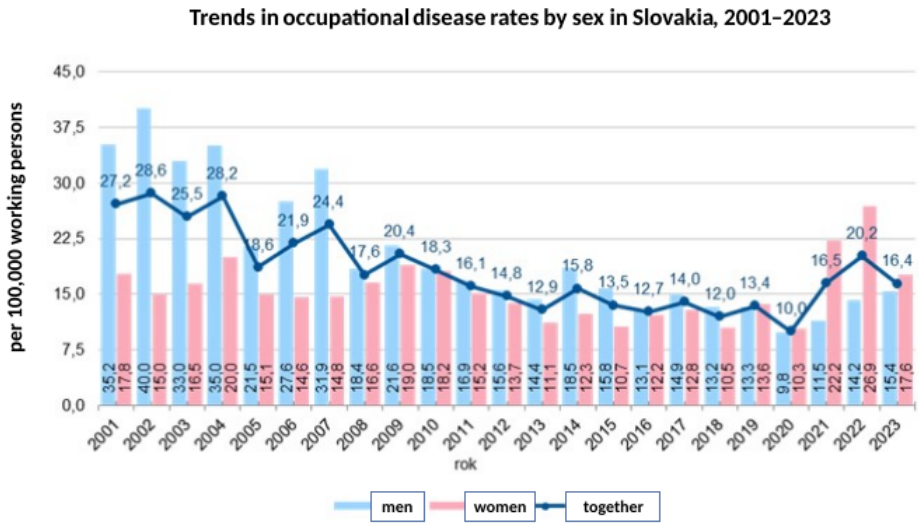
Occupational allergies are not monitored as a separate group; instead, individual diseases are listed in different sections of the occupational diseases register. Recognized occupational allergic diseases are relatively rare. However, given the global increase in allergic diseases over recent decades and the rapid emergence of new occupational technologies, awareness of this category is essential for diagnosing work-related allergies and implementing effective prevention strategies.

In an aging society, the period of professional activity frequently extends well into advanced old age (Sus2b, 2023). Healthcare for older adults, including older employees, sets higher professional requirements (Trnka, 2010), necessitates expanded treatment availability (Furtak-Pobrotyn, 2018), and entails above-average costs (Pobrotyn, 2020). Among other considerations, older individuals with chronic diseases, including allergic respiratory conditions, face an elevated risk of severe COVID-19 (Drobnik, 2021) as well as influenza and related complications (Drobnik, 2023), and awareness of these risks increases the popularity of vaccination in this age group (Sus2b, 2022). A growing challenge for the healthcare system stems from the emergence, in an aging population, of conditions and complications that were previously rare (Sus2b, 2015) or exhibit atypically severe courses (Sus2b, 2015), as well as malignancies (Pajewska, 2023) and mental disorders (Trnka, 2013), all of which affect the fulfillment of social and professional roles (Trnka, 2017). Consequently, particularly meticulous medical recordkeeping is required (Sus2b, 2009). Given widespread staffing shortages, healthcare can only meet these demands through the increasingly extensive use of modern technologies (Sus2b, 2023), including computer systems (Sus2b, 2008) and telemedicine (Grata-Borkowska, 2022), which in turn introduce new, previously unknown risks (Sus2b, 2017).

Epidemiology of Occupational Diseases

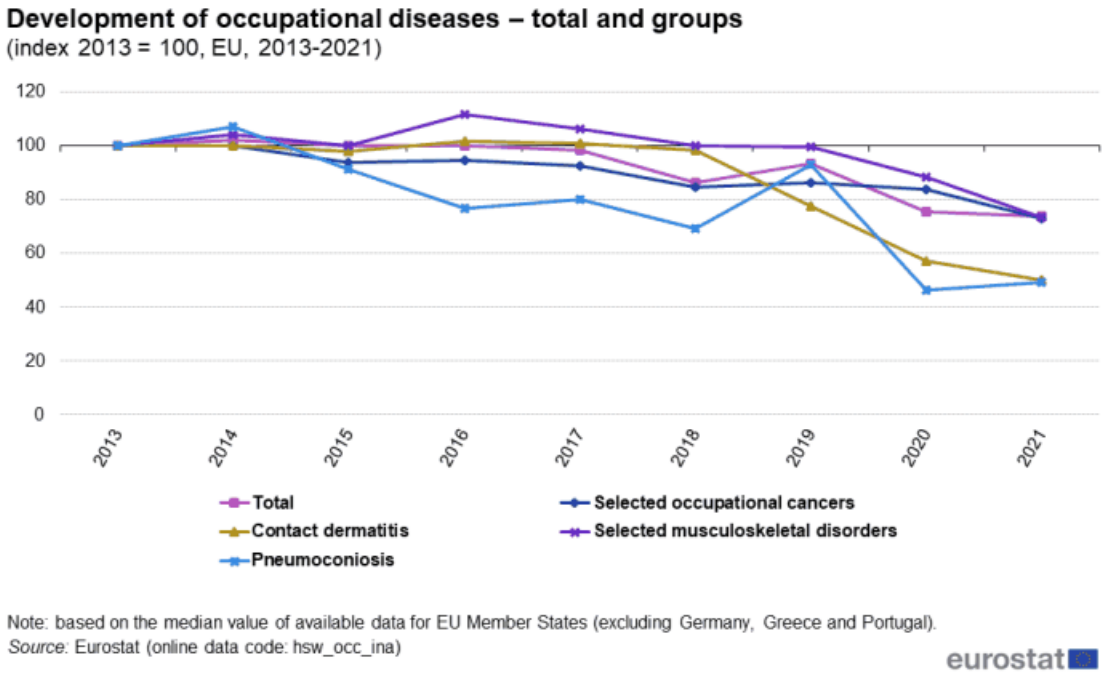
Over the past 20 years, the incidence of occupational diseases has been steadily decreasing globally. In 2023, 429 newly recognized cases of occupational diseases were reported in Slovakia, corresponding to 16.4 cases per 100,000 employed persons - nearly 20% fewer than the previous year (a decrease of 96 cases). The overall trend in occupational diseases in Slovakia has been declining over the past 20 years, too (Figure 1). However, the increase in cases among women in 2021 and 2022 was primarily due to the COVID-19 pandemic, as many female healthcare workers developed occupational diseases because of work-related COVID-19 infections. In 2023, the highest incidence of occupational diseases in Slovakia was recognized in industrial manufacturing (40%), healthcare and social assistance (30%), and mining and quarrying (15%) (NCZI, 2024).

Figure 1 Trends of occupational disease incidence by gender in 2001 – 2023 in Slovakia. Source: adapted from NCZI, 2024



Within the European Union (EU), the EU index value for the number of newly recognized individuals with an occupational disease decreased by 26% from 2013 to 2021 (Figure 2). The time series data is shown in Figure 2 using an index, where the value for 2013 is set at 100. The figure does not display the absolute number of people diagnosed with an occupational disease but focuses on the change in this number over time. Among occupational allergies, contact dermatitis is shown, exhibiting a declining trend (Eurostat, 2024).

Figure 2 Trends in occupational diseases in the EU from 2013 to 2021, overall and by groups of occupational diseases. Source: adapted from ec.europa.eu/eurostat/statistics.



Risk Factors of Occupational Allergies

The risk of developing and progressing occupational allergies is present in various industries with a wide range of allergens (Figure 3). In addition to employees in industry, occupational allergies can also occur in other workplaces (Figure 4). Therefore, a good understanding of potential allergens is necessary, along with interdisciplinary collaboration between occupational medicine specialists and clinical doctors, based on the clinical symptoms and impact on individual organ systems.

Figure 3 Risk industries for occupational allergic diseases



Figure 4 Risk workplaces for occupational allergic diseases outside industrial sectors



Diagnosis of Occupational Allergies

When experiencing any symptoms, the patients visit their general practitioner, who, upon suspicion of an occupational allergy, refers them to the appropriate specialist. The most common examinations are conducted by a clinical immunoallergist, and if necessary, by other specialists such as a dermatologist, pulmonologist, or otolaryngologist. The diagnostic methods differ according to the type of occupational allergy. If there is suspicion that the disease is related to the patient's work, an examination at an occupational medicine clinic is required to confirm or reject an occupational

disease diagnosis. A physician specializing in occupational medicine determines necessary work adjustments and potential compensation for the patient.

Prevention of Occupational Allergies

The risk of occupational allergy depends not only on the concentration of allergens but also on the available protective measures. In some cases, protective options are significantly limited, such as with airborne allergens like wood or flour dust and mold spores. For contact allergens, the lack of protective equipment use may result from negligence, convenience, or business interests. Avoidance of causative exposures through control strategies such as elimination, substitution, engineering controls, and process modification is the preferred primary prevention strategy for preventing development of work-related allergic diseases.

Personal protective equipment

To prevent occupational allergies, various workplace management measures are recommended. Depending on the type of work and potential allergens, protective gloves or respiratory protection equipment should be used. Gloves prevent contact with harmful substances and protect against chemical, mechanical, electrical, or thermal irritation. The type of gloves must be chosen based on the specific hazard. It is also recommended to wear cotton inner gloves under protective gloves, as they absorb sweat and are easy to replace. For respiratory protection can be used respirators, masks, and filtration devices (with or without an oxygen supply) that protect against airborne dust or gaseous substances. Regular filter replacement is necessary. These protective devices are particularly useful in welding, soldering, gluing, painting, and handling solvents or volatile substances.

Management of Occupational Allergy Prevention in Workplaces

There are few opportunities to completely avoid allergens in the workplace. Sometimes it is possible to transfer the worker to a different position, but often the employee must retrain for a different profession. Financial support is typically only available if the disease is recognized as an occupational disease (a process that is often very demanding and lengthy). In some cases, an occupational disease can lead to disability or early retirement.

Certain workplaces pose a particularly high risk for developing allergies, requiring appropriate preventive measures. However, in all industries, it is essential to monitor the allergens that employees are frequently exposed to. Standard protective measures may not be sufficient for allergy sufferers, as even small amounts of allergens can trigger significant reactions. Each workplace must provide employees with detailed information about potential allergens and the necessary protective measures. Occupational exposure limits for harmful substances are regularly updated and must be adhered to, but they may not adequately protect individuals prone to sensitization and allergic reactions, as these can occur independently of allergen concentration. Every employee must be aware that hypersensitivity or allergic reactions can develop at any time, even after years of working in the same profession. For example, hairdressers often develop allergies within the first year of training, while in other professions, significant symptoms may take years to appear, potentially preventing further employment in the field.

Choosing the Right Profession

When choosing a future profession, it is important to consider the risk of allergies, especially for individuals with a higher risk or in environments where these risks are increased. For atopic individuals, i.e., those with a higher predisposition to allergic diseases, as well as patients with developed allergies, it is crucial to assess the allergen exposure in the workplace and inquire about possible allergens. Testing before entering a job remains a subject of discussion, as the presence of sensitization does not necessarily mean that an allergy will develop. On the other hand, testing can lead to a false sense of security, as allergies may develop after years. A typical example is the allergy to chromium in cement among bricklayers, which can develop after the age of forty.

For new employees, it is recommended to consult a doctor if the first symptoms indicating a possible allergy appear, as these symptoms may worsen over time. In the case of a known allergy to substances in the work environment, it is crucial to consider

changing the job position and retraining, especially for younger people. In some countries, financial support is provided to employees who need to retrain. Protection from allergies should be ensured during the preparation for employment, not only for atopic individuals but also for healthy people without any signs of allergic diseases.

Classification of Occupational Allergies

Most of occupational allergic diseases can be categorized based on their localization to:

- Allergic contact eczema
- Allergic rhinitis
- Occupational bronchial asthma
- Extrinsic allergic alveolitis

Certain types of occupational allergic diseases are more common in specific professions, depending on the presence of allergens that typically cause allergic symptoms, most often affecting the skin or respiratory tract (Figure 5).

Figure 5 Classification of occupational allergies and their occurrence by profession



Professional Dermatoses

The occurrence of skin diseases related to work and the environment has been increasing in recent years. They have significant socio-medical, healthcare-political, and economic impacts. Young people at the beginning of their productive age are often affected. Irritative or allergic contact reactions are the most common. Skin diseases typically progress chronically and are often not initially associated with the type of work performed.

Diagnosis requires several years of experience with professional dermatoses. Treatment and retraining involve considerable financial costs, and those affected often struggle to find employment again. Costs increase when an occupational disease is recognized. Prevention and rehabilitation have significantly improved in recent years, thanks to advancements in dermatological procedures and interdisciplinary outpatient and hospital counseling.

Professional dermatoses most commonly present as contact eczema on the hands, where exposure is most significant. Two possible mechanisms apply. Direct skin irritation by a harmful substance can trigger irritant contact eczema. A delayed allergic reaction based on sensitization to an allergen causes allergic contact eczema. Clinically and histologically, they are usually indistinguishable. Irritative manifestations often precede the development of contact eczema as they weaken the skin's barrier function, and initial inflammatory changes in the skin's surface layer make sensitization easier, leading to the development of

contact eczema. Atopic eczema increases the risk of professional dermatoses.

A typical trigger for professional dermatoses in healthcare workers was latex, which spread through powder dust in latex gloves. Its significance has decreased with the use of non-latex gloves. Moisture present for at least 2 hours of work time increases the risk of developing an allergy. The most common allergens that cause professional dermatoses are chromium compounds in cement, epoxy resin (colophony), nickel, rubber components (thiuram, dithiocarbamate), disinfectants (glutaraldehyde, glyoxal, thiuram), preservatives and fragrances.

Due to the financial and time-consuming nature of the treatment, more emphasis is needed on preventing occupational dermatoses. *Primary prevention* includes using substitutes for irritating substances, reducing the content of the most allergenic substances, modernizing manufacturing technologies, regularly determining the highest permissible concentrations, tightening legislation, and thoroughly labeling harmful substances.

Technical measures used in primary prevention include cleaning machines or so-called enclosed machines, which offer better control over potential allergens. Organizational measures are also important, such as conducting a detailed analysis of skin exposure at the workplace, assessing workplace risks, regular changes between wet and dry work, and ensuring longer periods for drying items in production. Employees should participate in regular medical check-ups, use protective work equipment like gloves or protective creams, and engage in proper hand cleaning and hand protection for regeneration after work.

Secondary prevention involves early diagnosis and quick, effective treatment of emerging dermatoses. Advanced eczema has a much worse prognosis. In *tertiary prevention*, appropriate treatment procedures are sought for severe dermatoses, where good skin care is needed in collaboration with experienced dermatologists and coordination between dermatologists and occupational medicine specialists.

Occupational Allergic Rhinitis

Occupational allergic rhinitis is more frequently observed in workers in the food industry, textile industry, healthcare, carpenters, furniture makers, sawmill workers, and agriculture. The allergic rhinitis is a special type of work-related rhinitis that includes also different forms of rhinitis associated with the workplace of non-allergic occupational rhinitis.

The most common allergens include various types of flour, textile fibers, furs (flax, wool, cotton, synthetic fibers), hay, straw, feed mixtures, fungi, animal allergens (epithelium, feathers, insects), dust mites, food, latex, wood, formaldehyde, isocyanates, and more.

Diagnosis is challenging due to the need to distinguish between allergic and non-allergic forms. Clinical symptoms include repeated sneezing with a runny or stuffy nose, coughing, mucus drainage, and nasal swelling. It is often accompanied by itching of the eyes, nose, throat, or ears, dark circles under the eyes due to increased blood flow in the sinus area. To prevent contact with the allergen, personal protective equipment (masks, respirators) should be used at work, along with an appropriate work schedule, timely diagnosis and treatment, and possible early reassignment to another position.

Work-related rhinitis may precede development of work-related bronchial asthma, typically 5-6 months before asthma onset and therefore prevention, the early diagnosis and appropriate treatment can also prevent bronchial asthma.

Occupational Bronchial Asthma

Occupational bronchial asthma is the most common professional respiratory disease, accounting for 15-20% of adult asthma cases. Advances in industry and technology in Europe create new risk exposures for the respiratory tract. Many risk factors, such as nanoparticles, have not been clearly studied for their effects on the respiratory system or asthma development. Asthmatic symptoms often emerge after exposure to cleaning agents, irritants, or toxic substances.

When occupational asthma should be recognized as a work-related disease, the causal connection between asthma development and environmental factors at the workplace is crucial. Clinical manifestations include reversible airway hyperreactivity or bronchial obstruction. In the absence of the causative agent, hyperreactivity may be absent. It may depend not only on the causative agent but also on the activity being performed. Episodic asthma attacks occur primarily at the

workplace initially, but they may later occur outside of work, often accompanied by coughing and chest tightness. Symptoms include wheezing, expiratory dyspnea (difficulty breathing), and inflammation in the lower airways, which persists even after the resolution of asthma attacks. In later stages, especially when untreated, structural changes may occur.

Patients with existing asthma should avoid careers with a high risk of developing asthma, such as bakers, gardeners, animal caretakers, and similar occupations. Positive sensitization on different allergens (prick test, specific IgE antibodies) and bronchial hyperreactivity increase the risk of developing asthma. Workers at risk should undergo more frequent examinations during the first two years of employment. Patients sensitized to or reacting to allergens in the workplace should avoid such occupations. In addition to proper job placement and counseling, it is essential to minimize exposure to sensitizing or irritating substances in the workplace. This includes adhering to air pollution concentration limits, adequate dilution of substances, and the use of personal protective equipment. Technical protective measures include ventilated animal enclosures or the use of less dusty flour and granular substances in baking. For irritant substances, there are maximum permissible concentrations, but no such limits exist for allergenic substances.

Secondary and tertiary prevention of occupational bronchial asthma includes early diagnosis of occupational respiratory diseases of allergic origin, which is crucial for the disease's progression and prognosis. The risk of sensitization and the development of occupational asthma is highest during the initial years of employment. After successful diagnosis, it is essential to avoid exposure to the triggering allergen. The longer the exposure, the higher the risk of persistent bronchial hyperreactivity. A comprehensive patient management plan is necessary, from diagnosis to treatment, in collaboration with the primary care physician, pulmonologist, allergist, and occupational health specialist.

Exogenous allergic alveolitis

Exogenous allergic alveolitis is an immunologically mediated inflammatory reaction in the pulmonary parenchyma and terminal bronchioles with characteristics of interstitial lung disease. It is triggered by repeated inhalation of allergens by individuals who have been sensitized previously. The allergens are usually organic substances (bacteria, molds, mycobacteria, and proteins), and less commonly low-molecular-weight chemicals. Allergic inflammation occurs within hours to days, and in chronic forms, the diagnosis may not be made until pulmonary fibrosis develops.

One form of exogenous allergic alveolitis is *"bird fancier's lung."* It is most caused by budgerigars, cockatiels, or pigeons, with a high cross-reactivity between different bird species. It occurs in bird keepers but also in pet owners. The sources of allergens are protein components of excrement or feathers. Sensitization to molds and thermophilic actinomycetes, which can contaminate bird dust, is often present.

A common form of exogenous allergic alveolitis in Europe is *"farmer's lung."* It is caused by repeated exposure to moist hay and straw and the molds and bacteria (Aspergillus, Alternaria, thermophilic actinomycetes) contained within them. These microorganisms thrive under optimal conditions when hay is stored in barns, influenced by humidity, fermentation processes, and rising temperatures. When handling feed or bedding, fungal spores or bacteria are released into the air and subsequently inhaled by farmers.

A particular form involves lung disease caused by air conditioning systems. It is caused by contaminated humidifiers and air conditioning systems. It commonly occurs in carpenters, bookbinders, and printers, where air conditioning systems have been installed.

The clinical course of exogenous allergic alveolitis depends on the type of allergen, the intensity, duration, and frequency of exposure. From a time perspective, it can be acute, subacute, or chronic. The acute form typically appears 3-12 hours after repeated allergen exposure, with flu-like symptoms, fever, chills, headaches, body aches, respiratory difficulties, non-productive cough, chest tightness, and exhaustion. Crackles are often heard on lung auscultation. Symptoms resolve after the removal of the allergen without specific treatment within 24-48 hours. The subacute form results from recurrent, usually lesser allergen exposure. It is characterized by gradually worsening shortness of

breath, cough, fatigue, or weight loss over weeks to months. The chronic form can develop with prolonged minor exposure to allergens or repeated acute episodes – a chronically recurring form. This can progress to advanced interstitial lung disease, including pulmonary emphysema (farmer's lung). Effort-related dyspnea becomes more frequent. However, other chronic fibrotizing lung diseases must be differentiated.

Prevention of exogenous allergic alveolitis focus on preventing contact with the triggering allergen. *Primary prevention* also includes changes in working conditions, public education about potential sources of allergens, or targeted training for employees to reduce allergen exposure. For farmers, recommendations include switching from hay to silage feeding or from straw bedding to manure farming, as well as using special ventilation and heating systems in barns to reduce the presence of allergens. *Secondary and tertiary prevention* involves protecting the airways with respirators, regular preventive examinations, early diagnosis, treatment, and good management of existing exogenous allergic alveolitis.

Conclusions

Occupational allergies are mostly chronic diseases that are caused or exacerbated during work activities. Due to the overall increase in the prevalence of allergic diseases in recent decades, it is important to consider potential occupational allergies, the diagnosis of which can be more complicated, especially due to the necessity of proving a causal link to the allergen in the patient's work environment. Allergens causing occupational allergies are found in various working conditions. Prevention is crucial, including the use of personal protective equipment, preventive measures in the workplace, and good management of at-risk employees. In cases of suspected work-related allergies is very important early diagnosis, prompt and effective treatment, avoidance of the allergen, and if necessary, reassignment of the employee to another position.

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