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**Case Report**

# Occupational Exposure and Co-Occurrence of Work-Related Skin and Respiratory Disorder in Cleaner: A Case Report

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## Abstract

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**Key words:** allergic occupational contact dermatitis; cleaner; formaldehyde; patch test; sensitizer-induced occupational asthma; skin prick test.

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**BACKGROUND:** Despite the connection between skin and respiratory system in occupational disease is growing area of research interest, there is still a limited evidence for the effects of both airborne and skin exposures together with skin and respiratory outcomes.

**CASE PRESENTATION:** This report describes a 32-years old female with no previous history of atopy, asthma or skin disorders working as an office cleaner for three years. About two years after entering the actual workplace she developed episodic wheezing, shortening of breath and chest tightness. At the same time, she noticed eczematous lesions on the skin of both hands. She reported work-relatedness of both respiratory and skin symptoms, i.e. the symptoms improved during weekends and holidays and worsened when she returned to work. The patient was referred to Institute for Occupational Health of R. Macedonia for assessment of possible occupational asthma (OA) and occupational contact dermatitis (OCD). Diagnosis of asthma was confirmed by standard diagnostic procedure, while the diagnosis of sensitizer-induced OA was established by positive result of serial peak expiratory flow rate (PEFR) measurements at and away from work. Diagnosis of allergic OCD was confirmed by positive patch test to formaldehyde. The management of both diseases included complete removal from the harmful workplace exposure, as well as pharmacological treatment according to the actual recommendations.

**CONCLUSIONS:** This case report represents a description of a co-occurrence of work-related skin and respiratory symptoms in a female working as an office cleaner. Formaldehyde is found to be a causative factor of allergic OCD, and it also may be a causative factor of sensitive-induced OA in the same patient, but other occupational sensitizers cannot be excluded.

## Introduction

The connection between skin and respiratory system in occupational disease is growing area of research interest but the associations between exposure and symptoms, as well as the relationship between skin and respiratory effects are still unclear.

The hypotheses of how the skin and the lung may interact in terms of exposure and outcomes are complex. If a worker is sensitized due to dermal exposure, a respiratory response may be triggered by relatively low airborne exposure. This has implications for exposure control because airborne exposure limits may prevent airways sensitization but may not be protective for elicitation in the airways of a sensitized worker [1].

Despite the case reports of co-occurring skin and respiratory disease attributed to occupational exposures, there is still very limited research in working populations regarding the co-existence of these outcomes. There are many studies of respiratory symptoms in working populations, comparatively not so much studies of dermal symptoms in working populations, but only few publishing studies that reported on co-existing skin and respiratory symptoms in certain occupations [2-5]. Results from the study carried on by Lynde et al. [6] which was focused on skin and respiratory symptoms in a group of professional cleaners showed that those cleaners with a current rash or a rash in the last twelve months were at significantly increased odds of reporting work-related respiratory symptoms compared with cleaners who did not have a rash.

The aim of this case report is to present a co-occurrence of work-related skin and respiratory symptoms in a female working as an office cleaner.

## Diagnostic work-up

The diagnostic work-up in this case began with clinical and working history taking, clinical examination and spirometry. Skin prick tests (SPTs) to common inhalant allergens (birch, lime, grass mixed, plantain, *Dermatophagoides pteronyssinus*, fungi mixed, dog hair, cat fur, and feathers mixed) was performed and interpreted according to the actual recommendations [7]. Atopy was defined as a presence of at least one positive SPT to common inhalant allergens [8].

Bronchial responsiveness was evaluated by metacholine challenge test according to the actual recommendations [9, 10]. The diagnosis of asthma was based on the history of asthmatic symptoms and positive metacholine challenge test [11]. The work-relatedness of asthma was evaluated by serial peak expiratory flow rate (PEFR) measurements according to the actual recommendations [12, 13]. The diagnosis of OA (sensitizer-induced OA) was established by finding of significant changes of the PEFR values registered in the periods at and away from work [14].

Patch tests to common occupational contact allergens (potassium bichromate, nickel sulphate, cobalt chloride, p-phenylenediamine, formaldehyde, thiuram mix, neomycin sulphate, balsam of Peru, latex and epoxy resin) was performed and interpreted according to the actual recommendations of the European Society of Contact Dermatitis guideline for diagnostic patch testing. Work-related eczematous skin lesions followed by positive patch test to certain common occupational contact allergen indicated diagnosis of allergic OCD [15-17].

## Results

A 32-years old never-smoking female with no previous history of asthma or skin disorders worked as an office cleaner for three years. Her working tasks included dusting, washing and polishing surfaces, walls and floors, as well as disposing of waste and wasted water. The workplace exposure included several types of cleaning products, such as soaps and detergents, disinfectants, solvents, and polishes; some of which being in spray form. These cleaning products contained several agents capable of causing irritation or/and allergic sensitization, such as their active compounds (chlorine, ammonia, caustic soda,

etc.), preservatives (formaldehyde, isothiazolinones, etc.), corrosion inhibitors (ethanolamines), biocides (quaternary ammonium compounds), scents (lemon, spine, etc.) etc. She usually, but not all the time during the work, used the protective equipment during her working (protective clothing, gloves and mask).

About two years after entering the actual workplace she developed episodic wheezing, shortening of breath and chest tightness. At the same time, she noticed eczematous lesions (redness, swelling, itching and fluid-filled blisters) on the skin of both hands. She reported work-relatedness of both respiratory and skin symptoms, i.e. the symptoms improved or disappeared during weekends and holidays and worsened or occurred when she returned to work. The patient was referred to Institute for Occupational Health of Republic of Macedonia for assessment of possible occupational asthma (OA) and occupational contact dermatitis (OCD).

At the time of diagnostic procedure, the patient (being about one month away from work) had neither respiratory symptoms nor skin lesions. There was no any respiratory or skin sign by clinical examination, the spirometric measurements showed normal values of the spirometric parameters, and skin prick tests to standard inhalant allergens were negative. Bronchial hyperresponsiveness (BHR) was registered by metacholine challenge (the metacholine provocative concentration that caused felt of FEV1 of 20% or more by its basal value was 1.23 mg/mL) suggesting the diagnosis of asthma. The work-relatedness of the disease was assessed by serial PEFR measurements at and away from work. Significant changes of the PEFR values registered at work compared to the PEFR values registered in the period away from work suggested diagnosis of sensitizer-induced OA.

Patch testing with common patch allergens showed positive result to formaldehyde suggesting the diagnosis of occupational OCD.

The treatment was initiated according to the actual recommendations. As the basis of both respiratory and skin disease was found to be occupational allergy, complete removal from the actual workplace was recommended.

## Discussion

OA and OCD are common problems in the workplace (i.e. workers can develop new disease, or aggravate existing disease, as a result of occupational exposures) and both diseases have an allergic and irritant form. In addition, there is evidence that some workers experience both respiratory and dermal symptoms, and that these symptoms may occur as a result of occupational exposure. There is evidence

that skin exposure may lead to sensitization that is relevant to the development of respiratory disease, i.e. that several common occupational exposures may cause disease in both the skin and respiratory system. On the other side, neither of these two areas, concurrent symptoms and cross-system sensitization, has been explored thoroughly in occupational studies [18].

There is significant overlap in agents/exposures that may cause OA and OCD. Of the ten most frequent occupational contact allergens (OCAs) (epoxy resins, thiuram, carba mix, nickel sulphate, cobalt chloride, potassium bichromate, glyceryl thioglycolate, P-phenylenediamine, formaldehyde, and glutaraldehyde), seven were listed in the *Asthma in the Workplace* as exposures capable of causing OA (all except thiuram, carba mix and thioglycolate) [19]. In addition, of the ten most frequent OCAs, epoxy resin, nickel sulphate, cobalt chloride, potassium dichromate and glutaraldehyde according to the systematic literature review were classified as having established association with OA. Formaldehyde and PPD were classified as possibly associated due to discrepancy between the two reference documents [18].

This case report is a description of co-occurrence of work-related skin and respiratory symptoms in a 32-year old female working as an office cleaner for three years. She had not any dermal or respiratory problem before entering the actual workplace, i.e. the symptoms appeared two years after she began the actual work. Both dermal and respiratory symptoms occurred at the same time showing clear work-relatedness. She was referred to the Institute for Occupational Health of Republic of Macedonia, Skopje almost two years after occurrence of the symptoms being previously treated by general practitioner. At the Institute she underwent the standard diagnostic procedure and the diagnoses of allergic OCD caused by formaldehyde and sensitizer-induced OA were established. As we were unable to perform the specific inhalation challenge (SIC) with certain occupational agent, the causative factor of allergic-sensitized OA could not be detected. It may be formaldehyde, but other workplace agent could not be excluded. After the diagnosis was established, a treatment with asthma controller (inhalant corticosteroids in low dose) was initiated according to the actual recommendations of the Global Initiative for Asthma (GINA) [11]. At the same time, removal from the harmful workplace was strongly recommended.

Formaldehyde is commonly used as a preservative and disinfectant in cleaning products. Furthermore, formaldehyde may be released by other preservatives in cleaning products, i.e. by terpenes, the main constituent of essential oils derived from oranges, lemons, other citrus, lavender, thyme, cedar wood, pine, and other plants, flowers, and trees that react with ozone from air pollution producing formaldehyde, acetaldehyde and other volatile

carbonyls [20]. Formaldehyde is a low-weight-molecule (LMW) compound which may cause adverse healthy effects in exposed individuals, primary in exposed workers. Namely it is well established that formaldehyde may cause sensitizer-induced OA and allergic OCD in susceptible workers [21, 22]. As it is case with majority LMW agents, formaldehyde causes sensitizer-induced OA by mechanisms which do not include Immunoglobulin E (IgE)-mediated allergic reaction (i.e. non-IgE-mediated sensitizer-induced OA or IgE-independent sensitizer-induced OA), so allergic sensitization to formaldehyde can not be confirmed by skin prick test [23, 24]. On the other side, skin sensitization to formaldehyde occurs due to delayed type of hypersensitivity (IV type allergic reaction), so it can be demonstrated by patch test with this agent [22, 25]. In addition, by the International Agency for Research on Cancer (IARC), formaldehyde is classified as a known human carcinogen for laryngeal cancer [26].

Limitation of the present case report is that SIC was not performed and the causative agent of the sensitizer-induced OA was not documented. Although the SIC may produce false positive and false negative results, it is considered as a gold standard for diagnosis of sensitizer-induced OA. On the other side, this case report is a contribution to still poor evidence of the co-occurrence of skin and respiratory allergic disorders in outpatient settings.

In conclusion, this case report represents a description of a co-occurrence of work-related skin and respiratory symptoms in a female working as an office cleaner. Formaldehyde is found to be a causative factor of allergic OCD, and it also may be a causative factor of sensitive-induced OA in the same patient, but other occupational sensitizers can not be excluded. As there is some evidence about the connection between skin and respiratory system in occupational disease, further studies are necessary to improve the knowledge for the effects of both airborne and skin exposures together with skin and respiratory outcomes. Additionally, there is a need for a more specific approach for diagnosis and management of the patients suffering from work-related skin and respiratory allergic disorders.

## Authors Participations

JM participated in the study design, data collection, managing the analyses of the study, and writing all versions of the manuscript. JKB and TE participated in the study design, managing the analyses of the study, as well as writing all versions of the manuscript. SS and DM participated in the data collection and in the managing the analyses of the study. All authors read and approved the final manuscript.

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