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LETTER TO THE EDITOR

On the urgency of air pollution control to manage chronic eye rubbing and probable risk of keratoconus

Dear editor in chief,

This letter attempts to address the linkage between air pollution and ocular allergies leading to other complications such as keratoconus (KCN) disease. The rapid growth of urbanization and continued industry development have led to the rising emission of many different pollutants into ambient air. Also, the heating and cooling of modern houses are gaining importance to reduce costs; accordingly, recent buildings are facing poor air quality due to air-tight and poor ventilation conditions. Current literature shows that exposure to air pollution has made the greatest hazard to major body systems such as the respiratory and cardiovascular systems. Also, healthcare costs and hospital admissions are enhanced as this phenomenon escalates. Overall, it is confirmed that the health concerns associated with air pollution tend to worsen with time around the world.[1,2]

In recent decades, the prevalence of allergic reactions has constantly grown worldwide and air pollution is considered a major contributing factor. Allergies may trigger various symptoms such as conjunctivitis, dry eyes, runny nose sneezing, coughing, itchy throat, eczema, and certain inflammatory skin disease. It is worth noting that air pollutants such as dust, NO_2, O_3, $PM_{2.5}$, PM_{10}, SO_2, CO, pollen, dirt, and lint either indoors or outdoors play the greatest role in the incidence of allergy symptoms. These airborne pollutants are known as important sources of air pollutants that originate from plenty of natural and anthropogenic sources, such as vehicle exhaust, power plants, fossil fuels, volcanoes, forest fires, waste deposits, agriculture, atmospheric photochemical reactions, cooking stoves, and heating systems.[3]

Primary care providers often overlook ophthalmological complaints arising from allergic responses. These ocular complaints mostly include dryness, irritation, redness, foreign body sensation, tears, and blurring of vision. The starting point for treatment of these symptoms includes the use of tear substitutes, which flush allergens from the ocular surface, as well as topical antihistamines and mast cell stabilizers. Corticosteroids remain among the most potent pharmacologic agents used in the more severe variants of ocular allergy and are effective in the treatment of acute and chronic forms of ocular allergic conjunctivitis. While physicians who currently treat ocular allergy have a greater familiarity with the signs and symptoms of allergic disease, misuse of topical and systemic corticosteroids by patients may even cause severe complications of acquired cataracts and secondary glaucoma.[4] It is reported that air pollution exposure exacerbates allergic symptoms in the eye through oxidative stress, toxicity, and inflammation.[2] Consequently, unaddressed allergic eye symptoms trigger the habit of chronic eye rubbing; Rubbing can worsen tissue damage and increase proteases like matrix metalloproteinase-9. Elevated serum IgE indicates an allergy, triggering histamine and IL-13 release, which activates itch receptors.[5] Unfortunately, chronic eye rubbing may lead to the development and progression of keratoconus or KCN disease. 48% of patients with keratoconus have eye-rubbing behavior ($P = 0.018$).[6] Through an indirect association, such complications are likely to develop during vigorous and prolonged rubbing habits.[7]

The KCN disease is a non-inflammatory disease of the cornea, where the cornea thins and changes its shape. Originally, the cornea is round or spherical, but during keratoconus, the cornea becomes convex and conical. Thinning and changing the shape of the cornea from spherical to conical form leads to irregular myopia-astigmatism and thus reduces vision. Although the etiology of KCN is complex and involves a multifactorial origin such as demographic and environmental factors, some studies confirm the role of eye rubbing as an important risk factor in developing keratoconus.[8]

Therefore, air pollutants both directly and indirectly constitute an imminent risk for the occurrence of keratoconus. In direct pathways, they are thought to exacerbate known risk factors such as eye rubbing and atopy. In an indirect pathway, air pollutants like PM could affect the cornea by inducing the apoptosis of epithelial cell types and interacting directly with stromal collagen.[9] studies shows a significant positive correlation between prevalence of keratoconus with particles rate of PM2.5 ($R = 0.58$; $P < 0.001$), PM10 ($R = 0.67$; $P < 0.001$) and NO2 ($R = 0.64$; $P = 0.00016$).[10]

To conclude, we would like to close this letter by warning that air pollution through allergic development and subsequently atopy and eye rubbing should be introduced as an important risk factor in developing keratoconus in the

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population exposed. The increased incidence of keratoconus further underscores the importance of air pollution control and prevention of individual exposure to preventable risks through effective policies and strategies as part of the responsibility of the governments. This letter also highlights the need to enhance public awareness about the effect of eye rubbing on keratoconus and the necessity of treatment and prevention of itching and dryness as the main causes of eye rubbing.

CRediT authorship contribution statement

Ebrahim Shirzadeh: Conceptualization. **Nematullah Shomoossi:** Writing – original draft. **Hadi Hasani:** Writing – review & editing, Project administration, Supervision.

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Ebrahim Shirzadeh[a], Nematullah Shomoossi[b], Hadi Hasani[c,*]

[a] *Department of Ophthalmology, School of Medicine, Sabzevar University of Medical Sciences, Sabzevar, Iran*
[b] *School of Medicine, Sabzevar University of Medical Sciences, Sabzevar, Iran*
[c] *Department of Medical Surgical Nursing, School of Nursing and Midwifery, Tehran University of Medical Sciences, Tehran, Iran*

[*] Corresponding author at: Departmet of Medical Surgical Nursing, School of Nursing and Midwifery, Tehran University of Medical Sciences, Tehran, Iran.
E-mail addresses: hasani1376@gmail.com, h-hasani@razi.tums.ac.ir (H. Hasani).