

Global warming and allergy in Asia Minor

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Abstract The earth is warming, and it is warming quickly. Epidemiological studies have demonstrated that global warming is correlated with the frequency of pollen-induced respiratory allergy and allergic diseases. There is a body of evidence suggesting that the prevalence of allergic diseases induced by pollens is increasing in developed countries, a trend that is also evident in the Mediterranean area. Because of its mild winters and sunny days with dry summers, the Mediterranean area is different from the areas of central and northern Europe. Classical examples of allergenic pollen-producing plants of the Mediterranean climate include *Parietaria*, *Olea* and *Cupressaceae*. Asia Minor is a Mediterranean region that connects Asia and Europe, and it includes considerable coastal areas. Gramineae pollens are the major cause of seasonal allergic rhinitis in Asia Minor, affecting 1.3–6.4 % of the population, in accordance with other European regions. This article emphasizes the importance of global climate change and anticipated increases in the prevalence and severity of allergic disease in Asia Minor, mediated through worsening air pollution and altered local and regional pollen production, from an otolaryngologic perspective.

Keywords Allergy · Asia Minor · Global warming

Introduction

Climate change, and global warming in particular, is potentially the largest global threat to human health ever encountered. The earth is warming, and it is warming quickly. Global warming is caused by human activity, such as urbanization, increased emissions and increased land use. Such activities have a major impact on climate through the greenhouse effect. The greenhouse effect refers to the role played by gases in the Earth's atmosphere that effectively trap energy from the sun. Without these gases, the planet would be too cold to sustain life as we know it. The most important of these gases is water vapor; the concentration of water vapor changes little and plays almost no role in recent human-induced greenhouse warming unlike other greenhouse gases, released mainly by the burning of fossil fuels, which include carbon dioxide, methane and nitrous oxide. The concentration of carbon dioxide has risen by more than 30 % since 1800 [1, 2]. Temperature records going back to the late nineteenth century show that the average global temperature has increased by about 0.6 °C in the twentieth century, which is also consistent with temperature trends (Fig. 1a, b) [1].

This article emphasizes the importance of global climate change and anticipated increases in the prevalence and severity of allergic disease in Asia Minor mediated through worsening air pollution and altered local and regional pollen production from an otolaryngologic perspective. Our main purpose is to raise the awareness of this phenomenon and to initiate preventive strategies by the governing bodies. Epidemiological studies have demonstrated that global warming is correlated with the frequency of

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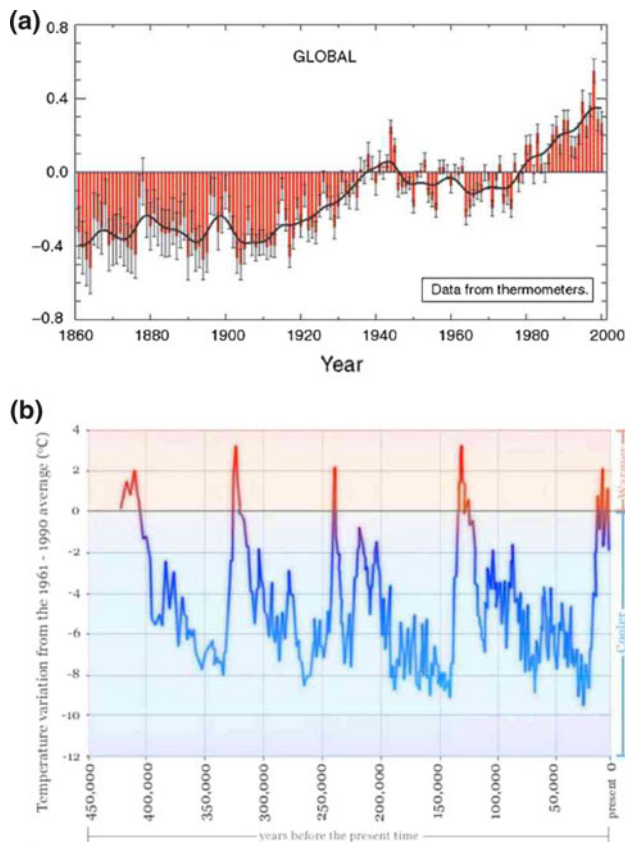


Fig. 1 **a** Departures from normal temperature (°C) from 1861 to 2000. **b** Global temperature trends for the past 425,000 years

pollen-induced respiratory allergy and allergic diseases. By inducing airway inflammation, air pollution overcomes the mucosal barrier that triggers allergen-induced responses. Climate changes may induce negative effects on respiratory allergic diseases. The increased length and severity of the pollen season, the higher occurrence of heavy precipitation events and the increasing frequency of urban air pollution episodes suggest that environmental risk factors will have a stronger effect in the upcoming decades. If certain prevention strategies are not employed soon, future generations may face more allergy-related health problems that would result in a greater financial burden on society.

Pollen and climate change

Pollen-induced allergic diseases such as asthma, rhinitis and atopic dermatitis are important health problems worldwide. There is a body of evidence suggesting that the prevalence of allergic diseases induced by pollens is increasing in developed countries, a trend that is also evident in the Mediterranean area [3–5]. Allergies to airborne pollens might increase or change in pattern due to the invasion of new allergic plants or to different plant behaviors, including earlier flowering which results in a

longer pollen season. Avoiding exposure to allergens constitutes the first and most important phase in the treatment of allergic diseases. Clinicians use this information to identify appropriate allergens for skin testing and to guide pharmacologic and immunotherapeutic interventions and allergen avoidance. Thus, the pollen map in an area is of great importance because the study of pollinosis cannot be limited to national boundaries. Because of its mild winters and sunny days with dry summers, the Mediterranean area is different from the areas of central and northern Europe. Classical examples of allergenic pollen-producing plants of the Mediterranean climate include *Parietaria*, *Olea* and *Cupressaceae* [4, 6, 7]. Aeroallergens have been analyzed since 1873 [6]. The Mediterranean area is geographically complex, with widely differing climates and a wide spectrum of vegetation. While some plants were thought to be characteristic of a particular region, clinical and aerobiological studies have clearly shown that the pollen maps of Europe and Mediterranean are changing. In the last 30 years or so, aerobiological studies have been developed in North America, in most parts of Europe and in the Mediterranean. Recent data suggest that the duration of the ragweed (*Ambrosia* spp.) pollen season has been increasing in recent decades as a function of latitude in North America. Latitudinal effects on increasing season length are associated primarily with a delay in the first frost of the fall season and lengthening of the frost-free period. Overall, these data indicate a significant increase in the length of the ragweed pollen season by as much as 13–27 days at latitudes above $\sim 44^{\circ}\text{N}$ since 1995. This is consistent with the recent Intergovernmental Panel on Climate Change projections regarding enhanced warming as a function of latitude. If similar warming trends accompany long-term climate change, greater exposure times to seasonal allergens may occur, with subsequent effects on public health [8]. In the case of Basel, Switzerland where 38 years of pollen data are available, it was shown that the start of flowering in the case of birch occurred about 15 days earlier due to a temperature increase. Apart from a shift in the start of flowering, there is also a trend toward higher annual birch pollen quantities and an increase in the highest daily mean pollen concentrations [9]. A review article by D'Amato et al. [3] gives up-to-date pollen data for Europe. Details of these data are beyond the scope of this chapter.

Asia Minor is a Mediterranean region that connects Asia and Europe and includes considerable coastal areas. It is a peninsula of western Asia between the Black Sea and the Mediterranean Sea. The peninsula is in western Asia and includes much of Turkey. Data from various cities in Asia Minor have been reported in the literature. Gramineae pollens are the major cause of seasonal allergic rhinitis in Asia Minor, affecting 1.3–6.4 % of the population, in accordance with other European regions [10–12]. The first

reported pollen count was conducted in 1967 in Ankara. Ankara is situated in central Asia Minor at an altitude of 870 m above sea level. It has dominant steppe vegetation and is 70 km from natural *Pinus* forests. In the early years of the Republic of Turkey, there was an increase in plantation in and around Ankara, owing to its arid properties. As a result of this development of the city, many species, particularly trees such as *Populus*, *Platanus*, *Acer*, Cupressaceae/Taxaceae, *Fraxinus* and others with varying allergenic properties, are seen in the city, creating a high tree pollen load for allergic patients. Many studies performed in the Ankara region have agreed that tree pollens comprise the majority of the pollen load, whereas grass and weed pollens constituted less than 10 % of the total yearly pollen counts [13, 14]. Another study was conducted in Adana, which is a typical Mediterranean city located in the southeastern part of Asia Minor. The city is surrounded by the Taurus Mountains and is covered with Pineaceae species. The study showed that Cupressaceae pollens are present for a longer period, from November to the end of June, than in Europe. *Betula* pollen is present for a shorter period than pollens in Middle European countries in November and December. Between March and June, the Oleaceae pollen distribution is similar to that in other European countries. Gramineae species are present throughout the year. Urticaceae pollen is present between March and June, which is shorter period than found in other European countries. Compositae pollen is present in different months, as compared to the situation in Europe (March–November in Asia Minor vs. July–December in Europe). The Chenopodiaceae/Amaranthaceae family is also present for a very long period in Adana. In general, tree pollen with a percentage of 82 % is slightly higher than that in the inner (76 %) and other parts of Asia Minor [15]. Finally, the results of a study from Istanbul, which is the biggest and the most populated city of Turkey that is located in the northwestern part, are reported here. In this study, the main pollen producers were characterized by certain allergenic pollens and identified as Cupressaceae/Taxaceae, Urticaceae, *Pistacia* sp., *Quercus* sp., *Platanus* sp., *Fraxinus* sp. and *Xanthium* sp. These pollen types contributed to the total pollen sum with a percentage of >80 % at both monitoring sites. The highest amount of pollen grains was recorded in April [16]. These three cities have been mentioned in an effort to summarize the pollen distribution of Turkey.

Climate change in Asia Minor

The world is warming, and so is Asia Minor. From Turkey's perspective, one can observe that in the winter, the projected temperature increase is higher in the eastern half of Asia Minor. In the summer, this pattern is reversed,

and the western half of Asia Minor, especially the Aegean region, will experience temperature increases of up to 6 °C despite the fact that the area-averaged annual mean temperature increase for Asia Minor in its entirety is estimated to be around 2–3 °C. Seasonal precipitation trends for the period 1951–2004 are shown in Fig. 2. It is possible that higher temperatures are associated with higher levels of allergens such as house dust mites, pollens and molds. This opinion is consistent with the fact that areas with higher average annual temperatures in Asia Minor are located mainly in the coastal areas of the country, which is affected by a Mediterranean climate and has higher house dust mite levels than the inner regions [17, 18]. A longer pollen season and greater diversity of pollens may contribute to sensitization in these areas. Asia Minor has been affected by climate changes in recent decades. Maximum and minimum temperatures and the number of warm days and nights have increased across Asia Minor, while the numbers of cool days and nights have decreased. The projected average increase in the number of summer days is expected to be 59 days in 100 years [18].

Allergy in Asia Minor

From an otolaryngologic perspective, the majority of allergic diseases in our specialty consist of allergic rhinitis (AR). AR is classically defined as a symptomatic disorder of the nose induced by IgE-mediated inflammation after allergen exposure [19]. It has great importance because of its prevalence, impact on quality of life, impact on work/school performance and links with other comorbidities. AR reportedly affects 5–40 % of the general population and its prevalence is on the rise [20]. The economic burden of AR, including direct and indirect costs, is estimated to be \$2 to \$5 billion annually in the USA [21]. There are several reports throughout the world indicating an increase in AR prevalence. In Turkey, a large study conducted by Cingi et al. [22] showed, on the basis of self-reporting, that 23.1 % of the study population were considered to have AR. The prevalence of physician-diagnosed AR was 20.1 %. Data on the prevalence of AR are limited in Asia Minor. The prevalence of AR in schoolchildren and in the adult population is reportedly between 4.5 and 36.3 % and between 8.9 and 27.7 %, respectively [6, 7]. Furthermore, there seems to be substantial worldwide variation in the prevalence of AR [23, 24]. The Prevalence and risk factors of Allergies in Turkey study was planned to evaluate the prevalence of, and risk factors for, asthma and allergic diseases in Turkey. The data from 25,843 parents of primary school children, obtained from a cross-sectional questionnaire-based study, were examined, and the AR prevalence was found to be 17.5 % in males and 21.2 % in females [25]. However, data on the association

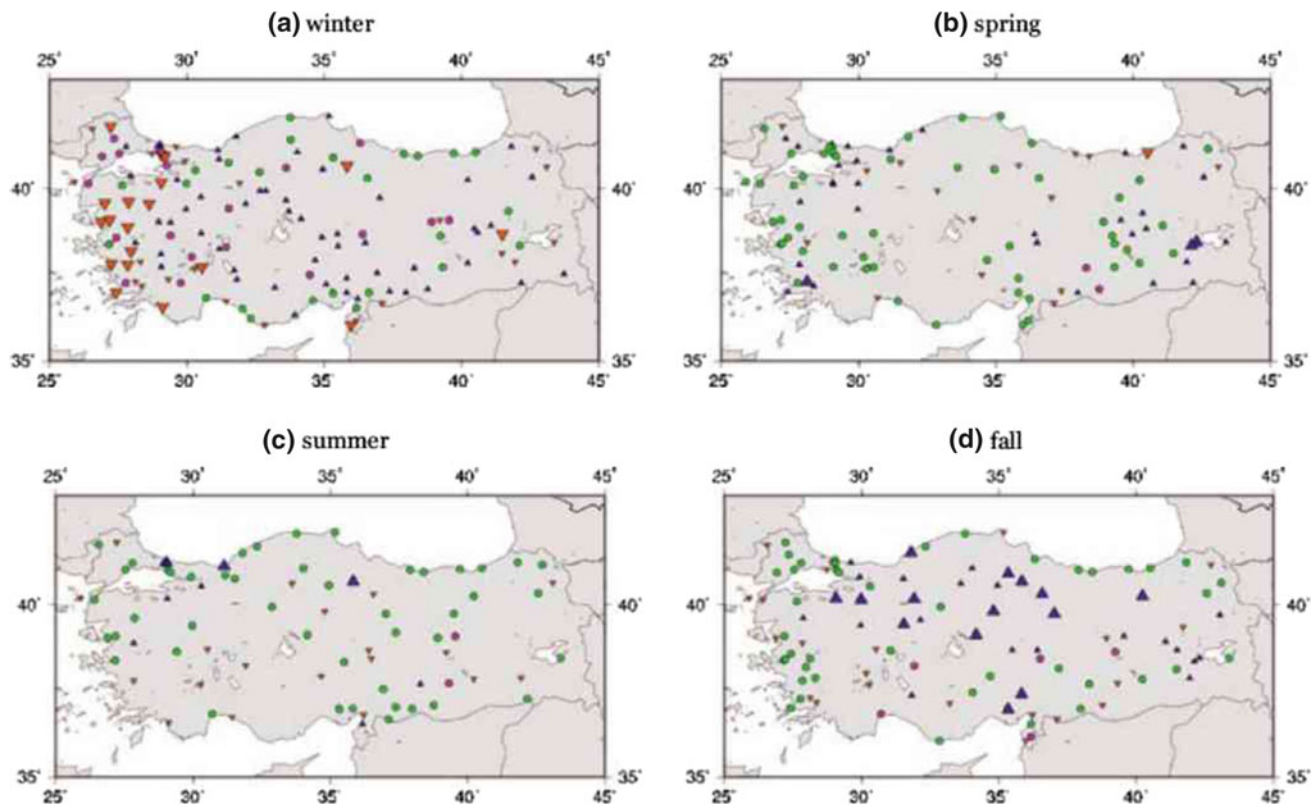


Fig. 2 Seasonal precipitation trends for the period 1951–2004. *Green circles* denotes no trend, *blue triangles* significant increase, *blue small triangles* insignificant increase, *red inverted triangles* significant

decrease, *red inverted small triangles* insignificant decrease, *brown circles* insignificant increases and decreases

of weather variables with pollen count and length of the pollen season in Turkey were not obtained. Regional pollen load has also, reportedly, had a major impact on the clinical presentation of seasonal respiratory allergies. Subjects living in regions with an overabundance of tree pollens reported having a high incidence of positive reactions to tree pollens.

Conclusion

Plants need a certain amount of heat to develop and produce pollen. Global warming appears to extend the pollen season and increase pollen production. There is strong evidence showing earlier onset of flowering and higher pollen production [26]. As a result of global warming, the types of pollens are changing and the allergenicity of those pollens is increasing [26, 27]. Global warming is not the only factor that affects pollen count and duration of the pollen season. Humidity, number of cold days and air pollution also have certain effects. Increased CO₂ levels result in increased plant and tree growth and, thus, increased pollen production. When exposed to high levels of nitrogen dioxide and ozone in vitro, timothy releases

more allergen-containing granules. Air pollutants such as nitrogen dioxide, ozone, particulate matter and components of particulate matter including organic carbon and volatile organic compounds have been linked with increased allergic disease. Elements of pollution serve as transporters and depots for allergens, which then spread to new environments and remain present for prolonged periods of time. Increased temperatures change atmospheric air streams, which has consequences for winds at the surface of the earth and for the spreading of pollen [28]. There is an interaction between particles in polluted air and pollen that increases the risk of sensitization and the risk and severity of symptoms in previously sensitized individuals. The pollution part of this complex destroys the unspecific mucosal defense system, rendering the mucosa open for penetration of allergens [29]. In Asia Minor, we need large-scale, multicentric studies on the relationships between climate changes, air pollution, pollen distribution and allergic diseases. This is far beyond the scope of this article. However, it is essential to raise awareness on this matter immediately. We know that the Earth is warming and that pollen counts and pollen exposure are increasing; therefore, allergic disease prevalence is likely to be higher in the future, which will result in more people becoming

sensitized to more allergens and developing more allergic symptoms for longer periods of time. The medical and societal costs will then increase correspondingly. Both governments and health professionals should be aware and work together in the development of national environmental policies. The Director General of the World Health Organization has stated that, “Climate change will affect, in profoundly adverse ways, some of the most fundamental determinants of health: food, air, water. In the face of this challenge, we need champions throughout the world who will work to put protecting human health at the center of the climate change agenda” [30]. We should work together to stop and reverse the effects of climate change on the global scale if we desire a better future for ourselves and our children.

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