

## Chapter 2

# Allergy—Fact File

### 2.1 Global Burden of Allergy—An Estimate

In most of the developed countries, allergy has become one of the most common and widely effecting disorders and nowadays is considered to be a common clinical problem. An increasing trend in the occurrence of allergies is observed as societies become more prosperous and urbanized. At present, about 30 % of the adult human population and 40 % of the children suffers from either of the different types of this malady, like allergic rhinitis, urticaria, eczema, food and contact allergies and asthma during their normal life span. In the United States of America, allergy is considered to be the fifth leading chronic disease and when taken together, an estimated fifty million Americans suffer from all types of allergies. It is estimated that allergic rhinitis, contact dermatitis and asthma are among the fifteen most common diseases diagnosed by the physicians and health experts. Moreover, thirty six million people per year in USA suffer from seasonal allergy that leads to nearly loss of four million days at work and school with a national burden of \$18 billion. Recent survey suggests that allergy is diagnosed almost one in every four individuals and among all those manifestations, allergic rhinitis is the most prevalent one (30 %), particularly among young adults.

The risk of allergic sensitization and its development differs with age, with the young children being at the maximum risk. Sensitization to allergen plays a crucial role in the development of atopic disorders. Available information have shown that IgE levels are highest during childhood and fall rapidly between the ages of 10 and 30 years. As diagnosis of IgE-mediated disorders is challenging, physicians rely on a thorough interview on clinical symptoms, but allergy symptoms can arise from many different organ systems and vary in severity, and symptoms can coincide with several other diseases. Children and young adults are most susceptible to the hay fever and the occurrence of asthma is maximum among the children below ten years. The peak age for the onset of hay fever is in adolescence, and about 63 % of students are reported to have suffered from hay fever symptoms. In general, the boys are more prone to develop allergy than the girls, whereas, the young adult females are more likely to be affected by asthma. Sex differences tend

to decrease during the process of adulthood. The chance of having an allergy varies radically based on race and ethnicity. It was observed that ethnicity plays an important role in some allergies such as asthma; however it was not possible to separate racial factors from environmental influences and changes that occur due to migration. Interestingly, it has been suggested that different genetic loci are responsible for asthma, specifically, among people of Caucasian, Hispanic, Asian, and African origins. The death rate due to asthma among Afro-Americans is nearly 4–6 times higher than among Native Americans, and Hispanic populations especially Puerto Ricans, have much higher asthma prevalence and greater morbidity and mortality.

In general, asthma is more prevalent in ill developed urban settlements than their rural counterparts, specially among industrialized communities, which may be attributed to the poor air quality, increased air pollution, excessive automobile exhausts, change in life style and food habits and intolerable psychological stress, which is more pronounced among urban inhabitants. Urban air pollution has been one of the significant environmental and extrinsic etiologic agents responsible for allergic diseases. Ozone, nitrogen dioxide, as well as particulate matter generated by automobile traffic and industry contribute towards air pollution and subsequently asthma and other allergic disorders. Empirical data on public health and hygiene have shown that the industrialized and more urbanized countries have a higher incidence of allergic diseases, while the occurrence of such disease are quite stable in low or middle income developing countries (ISAAC 1998). In USA, Canada, UK, Ireland, New Zealand and Australia, the incidence of diseases related to nasobronchial allergies between children of age groups 13–14 years is highest in the world and accounts to nearly 32 % of allergic diseases (Gangal and Chowgule 2009).

Strong epidemiological evidence supports a relationship between air pollution and the exacerbation of asthma and other allergic diseases around the world, including under developed and developing countries. In the recent past, increase in air pollution or decrease in ambient air quality, metamorphic changes in life-style, use of fast foods and changes in dietary habit as a result of strong western influence, lack of proper treatment and negligence at the initial stages of complaints have led to an alarming rise in the incidence of allergic diseases round the world. Allergic asthma is a heterogeneous disease with interplay between genetic and environment factors, asthma is chronic inflammatory disorder causes recurrent episodes of wheezing, breathlessness, chest tightness and coughing particularly at night and early in morning. There has been a substantial increase in the incidence and prevalence of nasobronchial allergic disorders among all age, sex and racial groups, affecting 12–20 % of the population worldwide (Smith 1983). The situation is worst in most of the less prosperous and developing countries with weak economic condition. There are many factors such as living habits, occupation, humidity, climate, home standards and ventilation which have been attributed to such an increase.

## 2.2 Socio Economic Impact of Allergy

Allergic diseases are very common multi-factorial disease complex and have a noteworthy impact on the society as well as economy. Allergies impart a negative impact on health and well being as well as education and career achievement and thus had emerged as a major health and economic burden. They adversely affect the quality of life of the patient including their parents as well as other family members thereby leading to weaker school performance and lower productivity at work. In Western Europe the direct and indirect annual estimated costs is nearly 45 billion Euros. In USA, an estimated 40 million i.e. 25 % of the normal population have allergic diseases, and the annual medical cost associated only with allergic rhinitis is estimated to be nearly \$53.4 billion, excluding 20 million lost school days and 3.5 million lost workdays each year, that amounts to \$154 million direct wages loss only due to seasonal nasal allergies. As a matter of fact, there are up to 20 million days of decreased productivity from either due to symptoms or due to side effects of medication. For adults, allergy is the fifth leading chronic disease and a major cause of absenteeism, linked to depression and anxiety, affecting cognition and learning (Fineman 2002).

## 2.3 Allergy Is More Common in Urban Landscape

Evidences round the globe show that the allergic diseases are more common in more developed and civilized countries as compared to agricultural based or traditional countries. Within the developed countries, the incidence is higher among urban population, particularly among those living in the posh areas of the cities. It is estimated that in urban areas, nearly one in three children are allergic and 30–50 % of them develop asthma. It was also found that a number of different factors, like the poor air quality in urban settings due to increased environmental pollution, greater chances of indoor allergen exposure, dietary changes, housing architecture, water supply and highly stressed lifestyles had significantly contributed towards the higher incidence of allergic diseases in the urban areas (Ellwood et al. 2001; Pearce et al. 2007; Wood and Gibson 2009). Apart from these, several house hold management practices such as cleaning, dusting, keeping the pet indoor, smoking has also added towards the development of the disease. Several case studies related to public health and hygiene have demonstrated that, increased levels of vehicle emissions and westernized lifestyle are significantly associated with the increased frequency of respiratory allergic manifestations among people living urban areas compared with their rural counterparts. Evidences suggest that air pollution associated with increased level of ozone, nitrogen dioxide and sulphur dioxide in the atmosphere as a result of excessive diesel exhaust, is the main culprit behind the increased occurrence of the allergic diseases (D'Amato et al. 2005). Van Zijverden et al. (2000) demonstrated that a positive correlation exists between

these pollutants and increased allergen specific IgE production by stimulating T helper 2 cell (Th2)-mediated immune responses to common antigens and alter normal Th1/Th2 ratio towards a predominant Th2. Although it is known that Th2-mediated responses are involved in respiratory allergy to common allergens, carbonaceous particles like diesel exhaust particles and carbon black particles could play a stimulatory role in this process. It was noted that diesel exhaust particles can even promote primary allergen sensitization towards a neoallergen (Diaz-Sanchez et al. 1999) and also appear to twist cytokine release in favour of Th2 pattern. In fact, diesel exhaust particles act as immune-modulating agent and perform the function of an adjuvant during the sensitization phase of allergen response as well as aggravate the symptoms in sensitized individuals (Peden 2005).

## 2.4 Allergy: A Lifestyle Disorder

There are a number of evidences which suggest that many aspects of lifestyle and the environment may lead to the development of allergic diseases. Population-based surveys in the developed world indicate that the more affluent sections of the community have the highest prevalence of allergic sensitization and associated diseases. According to the hygiene hypothesis, as proposed by Strachan (1989), changes in lifestyle among industrialized countries have led to a decrease of the infectious burden and are associated with the rise of allergic and Autoimmune diseases. Allergic diseases are more common in western countries than in developing countries and the prevalence of allergic diseases has been increased at a rapid pace over the last few decades in the developing world too. In fact, higher prevalence of these diseases within western communities suggests that allergy is an 'illness of wealth'. However, it has started to rise in other countries which are becoming more developed. Even in the developing countries like India, the prosperous urban population, following western lifestyle appears to be more susceptible to allergic response, leading to increased incidence of allergic disorders. It is assumed that this rapid increase in its prevalence in genetically stable populations must be attributed to some other factors, possibly environmental or lifestyle factors. Evidences support that the underlying causes are different aspects of modern living, including more sterile surroundings, changing diet, air pollution, increased consumption of processed foods, possibly even obesity and sedentary lifestyles. The habit of smoking, snuffing, drinking, and tobacco chewing along with the use of unnecessary drugs can also contribute to this unwelcome situation in a more intensified manner. The formaldehyde present in rugs, upholstered furniture, wall paper, draperies, paints initiates coughing, sneezing, wheezing, sore on nasal passage, flu like symptoms, aggravates asthma, irritates throat and causes watery eyes, are being used indiscriminately in our day to day life. Increased use of foam mattress instead of conventional cotton mattress favours the growth and multiplication of house dust mites, which ultimately increases the chance and duration of exposure to that offensive indoor allergen.

## 2.5 Allergy Is a Big Burden in Western Communities—Controversies and Realities

In western lifestyle practices, clean environment, changes in dietary habits, indiscriminate use of antimicrobials, widespread vaccinations and indoor air quality problems lead to a pro-allergic condition. In other words, individuals living in too sterile environment are not exposed to enough pathogens to keep the immune system busy and active. As suggested by hygiene hypothesis, allergic diseases are initiated as a result of inappropriate immunological responses to apparently harmless antigens driven by a Th2 mediated immune response. As proposed by hygiene hypothesis, at first, insufficient stimulation of the Th1 arm of the immune system lead to an overactive Th2 arm, which in turn led to allergic response. Beside, the endotoxin (lipopolysaccharide) and allergen often occur together in indoor air, which may add to the inflammation process. In general, immunological and autoimmune diseases are less common in the developing world than the industrialized countries. However, an increasing trend in the incidence of immunological disorders have been noticed from a number of third world countries, as the country grows more affluent and presumably cleaner. Empirical evidences suggest that the indiscriminate use of antibacterial cleaning products augment the situation and as a result reduced exposure to microorganisms due to this sort of lifestyle changes, in developed countries is associated with increased prevalence of allergic disorders. At the same time infections in early childhood may protect against allergic sensitization (Strachan et al. 1996), particularly, exposure to food and orofaecal pathogens like Hepatitis A, *Toxoplasma gondii* and *Helicobacter pylori* reduce the risk of atopy (Chen and Blaser 2008). However, some gastrointestinal bacteria such as *Campylobacter jejuni*, *Yersinia* and *Clostridium difficile* were associated with higher prevalence of atopy. Although, bacterial, fungal and helminth infections under certain condition have a protective role against allergic diseases, the role of viruses is still controversial. It has been hypothesized that exposure to viral and bacterial infections and some vaccines in early life can enhance type 1 (Th1) immunity and the production of cytokines (IFN- $\gamma$ ) that inhibit directly the allergy promoting type 2 (Th2) immune responses (Barreto et al. 2006).

Thus it may be presumed that low socio-economic condition, high temperature, poor standard of living including housing conditions, lack of proper attention towards health and hygiene in most of the developing countries, predispose the inhabitants to infections and possibly higher prevalence of helminth infestations protect them from allergic sensitization.

## 2.6 Allergy: A Stress Related Phenomenon

Empirical evidences clearly indicate that the allergic responses are very much stress dependant and psychological stressors have direct and substantial adverse effect on existing allergic patients (Kilpelainen et al. 2002; Montoro et al. 2009).

To accommodate themselves with the uneven rat-race, human beings are generating more and more stress day by day. A close relation between high incidence of allergic disorders and Depressive symptoms as well as anxiety related disorders have also been documented by Lietzén et al. (2011). In fact, stress and depression enhance humoral immunity instead of cell-mediated immunity, favouring more IgE production and shift from Th1 to Th2, thus initiate allergic response. Sugerman et al. (1982) reported that psychiatric patients, particularly depressed one, showed higher IgE levels to specific allergen, and there are reports of substantial improvement of allergic skin disorders due to administration of anxiety medications. Recent view suggests that mood and psychological stressors can modulate allergic response, like atopic dermatitis (Novak et al. 2003).

The possible effect of sedentary lifestyle to lung function and daily activity have received little attention until recently (Platts-Mills et al. 1997). Spending excessive time in front of video screens, televisions and computers by most of the children, decreased in physical activity, which could influence the lung function. Thus decline in physical activity must be considered as a possible factor contributing to the severity of asthma (Platts-Mills et al. 2000).



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