difficult. Peat and colleagues suggest, with some supporting data, that the increased responsiveness in atopic children may be due to a much greater allergen load in a child's environment.[2] Compatible with such a mechanism is the lower frequency of wheeze in the Swiss mountains.

The studies of Peat *et al* and Anderson *et al* indicated that the number of episodes of wheeze in affected children had increased,[2 3] but Anderson *et al*'s study suggested, however, that the morbidity from asthma as indicated by days lost from school and interference with normal activities had fallen substantially over the 13 years of study. Hyndman and colleagues in a study from East Anglia found that the increase in admission to hospital of children with asthma, which has been reported from many countries, may be reaching a plateau or even falling (p 1596).[7] These are reassuring findings and could well be due to more effective treatment in those with recognised asthma. The greater willingness of doctors to diagnose asthma in children with recurrent wheeze is probably the single most important factor in improving treatment.[8]

The increase in the prevalence of asthma in children may well have serious implications for adults as 40% of children with infrequent trivial wheeze and 70-90% of those with more troublesome asthma continue to have symptoms in mid-adult life.[9] As yet studies have not shown an increase in asthma in elderly people, although it may be increasing in young adults.[10] If the increase in the prevalence in children continues into adult life this will create substantial health problems and may well have important economic consequences through time off work and the cost of treatment.

Prophylactic drugs, particularly inhaled corticosteroids, might be expected to increase the likelihood of childhood asthma resolving, yet there is no evidence to support this. The long term use of inhaled corticosteroids in children with more troublesome asthma has failed to alter permanently the long term course of the disease.[11] When inhaled steroids were stopped after 24-36 months of treatment the pattern of asthma rapidly returned to the pattern that had been present before they were started. Furthermore, increasing evidence exists that even low dose inhaled corticosteroids may have a prolonged growth suppressant effect in children with mild asthma.[12] The more widespread use of the currently available inhaled corticosteroids in the hope of modifying the natural course of asthma cannot be recommended. Their use should be limited to those children in whom asthma substantially interferes with the enjoyment of a normal lifestyle or in whom there is persisting airways obstruction. Whether the newer inhaled corticosteroids will have fewer side effects, particularly effects on growth, remains to be determined.

Ways to limit the increase in the prevalence of asthma and if possible to reduce it are clearly vitally important. Until the reasons for the observed increase are determined, however, it is not possible to suggest intervention strategies. The hypothesis of Peat and colleagues that the likely explanation is a change in the degree of exposure to allergens is interesting and is further discussed by Cullinan and Newman Taylor below (p 1585).[13] Reducing exposure to allergens, particularly to house dust mites, is expensive and substantially alters lifestyles. It is too early to recommend interventions in the absence of proof of efficacy and benefit.

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# Asthma in children: environmental factors

## *Increased sensitisation to inhaled allergens seems the most likely explanation for asthma's increased prevalence*

Two studies of asthma in children, using identical survey methods and objective assessments separated by a period of 10-15 years, have now been published; each shows an increase in asthmatic symptoms and airway hyper-responsiveness and in seasonal rhinitis.[1] (p1591).[2] The increased prevalence of asthma has been matched by, and is probably a manifestation of, an increase in sensitisation among children to inhaled allergens, such as those present in house dust, cat fur, and grass pollen.[3]

Although genetic factors are important in determining both the propensity to atopic disease and the specificity of the response to protein epitopes, the short period during which the increases in asthma and other allergic diseases have occurred suggests that environmental influences have been mainly responsible. For example, secular trends in the Finnish armed forces show a 20-fold increase in asthma among 18 year old recruits during the past 30 years.[4]

Further evidence of important environmental influences comes from the recent observation that sensitisation to common aeroallergens is about twice as common among children in Munich as among genetically similar children in two cities that were formerly in East Germany, Leipzig and Halle.[5] Against this background it is valuable to consider what environmental changes have been common to Western countries in the past 30 to 40 years.

Childhood asthma is predominantly an allergic disease; changes may have occurred in exposure to aeroallergen (quantitatively or qualitatively) or in concurrent exposure to factors that modify the response to allergens. These factors include various respiratory irritants, such as tobacco smoke

and possibly air pollutants. Tobacco smokers have an increased risk of sensitisation to agents inhaled at work, including proteins[6] and low molecular weight chemicals.[7] Experiments in animals have shown that sulphur dioxide[8] and ozone[9] increase the risk of both sensitisation and airway responsiveness to inhaled allergens and haptens. Longitudinal studies of workforces exposed to respiratory sensitisers suggest that the highest incidence of sensitisation occurs within two years of new employment, and concomitant exposure to respiratory irritants (cigarette smoking) increases the risk of sensitisation during this period.[7] There may be a "window of vulnerability" in the period after initial exposure to novel allergens during which the effects of exposure and any modifying factors are maximal.

The development of allergy in infancy is probably influenced by factors in fetal life as well as those present after birth such as exposure to inhaled allergens. The level of exposure to house dust mite in infancy is related to the subsequent development of specific sensitisation and asthma,[10] and measurements in Australian homes suggest a secular rise in such exposures, though surprisingly no sensitisation to dust mites.[2] But this mechanism alone would be unlikely to account for the rising rates of sensitisation to other inhaled allergens. The role of infection in early life is being reconsidered in response to observations of an inverse relation between family size and rates in children of skin test sensitivity and associated manifestations of allergic disease including asthma.[11] Childhood exposure to respiratory infections tends to occur earlier in large families, and viral infections may down regulate production of IgE, possibly via $\gamma$ interferon production through preferential stimulation of TH1 lymphocytes, although this mechanism has yet to be demonstrated.

## Which irritant?

The respiratory irritants that have received most attention are cigarette smoke and atmospheric pollutants, particularly motor vehicle exhaust emissions. Infants spend most of their time in the home, and domestic sources of pollution are probably at least as important as external ones. Current evidence for a direct effect of nitrogen dioxide, particulate matter, and other such exposures on the development of allergic sensitisation in children is inconclusive. Any potential modifying role on the response to exposure to aeroallergen has, however, not been formally examined.

Interestingly, the secular rise in asthma in Britain has coincided with a high rate of smoking among young women. Maternal smoking during pregnancy seems to affect infants' lung function independently of postnatal exposure to tobacco smoke[12]; smoking may also influence cord IgE concentrations.[13] In the Tucson Children's Respiratory Study the proportion of children with episodes of lower respiratory illness during their third year was directly proportional to their cord IgE concentrations, although the relation was inverse during their first year of life.[14] Apart from emphasising that much wheezing in the first three years of life is not asthma, these findings suggest that changes in perinatal exposure to modifiers of the response to aeroallergens may be at least as important as changes in exposures to allergens themselves. The mechanisms behind any such modification, particularly that occurring before birth, however, remain obscure.

The explanation behind the rising incidence of childhood asthma is undeniably complicated and remains poorly understood, but several recently appreciated features are worth emphasising. Wheezing associated with viral infection in the early years of life needs to be clearly distinguished from childhood asthma: influences in both infant and fetal life, and their interactions, are probably important. Changes in exposure to aeroallergens alone seem unlikely to be solely responsible.

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