Vitamin D and asthma

Maternal diet vs lack of exposure to sunlight as the cause of the epidemic of asthma, allergies and other autoimmune diseases

Scott T Weiss, Augusto A Litonjua

Role of vitamin D deficiency in allergic and autoimmune diseases

Asthma is occurring in epidemic proportions with more than 300 million affected subjects worldwide. In almost all cases the disease has its onset in early childhood, with 80–90% of all cases initially being diagnosed before the age of 6 years.1 2 It was not always so. In the early 1970s the prevalences of asthma and allergy were roughly half of what they are today, and although the onset of the asthma epidemic started insidiously and cannot be precisely documented, it has several interesting and important features that have defied a unified explanation until now. There is clearly a North/South equatorial gradient with Western industrialised countries furthest away from the equator (New Zealand, Australia, the UK) having the highest prevalence worldwide. There is also a clear urban/rural gradient with rural areas in the southern hemisphere having the highest prevalence worldwide. The answer to this question has been the subject of a truly landmark study from New Zealand15 which studied 1350 non-insulted homes with low income families. The houses were generally stand-alone wooden homes on piles, with heating of a living room only. Two-thirds of homes had damp and three-quarters had visible mould. The homes had at least one household member with respiratory symptoms in the last year or a history of asthma, pneumonia or chest infections.

The role of vitamin D deficiency in allergic and autoimmune diseases

The role of vitamin D deficiency in allergic and autoimmune diseases...

...Role of vitamin D deficiency in allergic and autoimmune diseases...
Based on the epidemiological data to date, it is likely that deficiencies of both vitamins D and E are contributing to the epidemic and both deserve further study. However, in our view, the vitamin D story is the clearer of the two. Our interest in vitamin D devolved directly from having positioned cloned the gene for the vitamin D receptor as a gene for asthma.14 We then investigated it in epidemiological studies.10–11 It seems likely that a gradual decrease in exposure to sun due to sun avoidance behaviours in Western societies (sunscreen, clothing, sun avoidance, increased time spent indoors) reached a critical level in the early 1970s, such that humans were not spending enough time outdoors and vitamin D levels reached acutely low levels. Vitamin D is essential to the normal functioning of the human immune system. It is the on/off switch for vitamin D-dependent T cell responses. Vitamin D deficiency is the only factor that can explain all epidemiological aspects of the allergic and autoimmune disease epidemics noted above, and now the hypothesis that urgently needs testing is whether replenishment of pregnant women with vitamin D will have a major impact on the occurrence of all autoimmune diseases, particularly if it is followed by subsequent sufficiency of vitamin D in the developing child and adult. Although there are contrary epidemiological data linking vitamin D as a cause of asthma, in our view these studies have substantial methodological flaws, most importantly the lack of assessment of vitamin D status in childhood and serious loss to follow-up, thus invalidating their conclusions.20–21

The role of vitamin E is less certain. A careful look at the data on vitamins D and E in the VIVA and Aberdeen studies suggests that vitamin E has a greater effect in Aberdeen and vitamin D has a greater effect in Boston. This is, in our view, an artifact of the very low levels and lack of variation in estimates of vitamin D intake in Aberdeen which limit the detection of the effect of vitamin D in that population. In addition, while there is a large body of evidence that vitamin D deficiency to Th1 autoimmune disease, the evidence for vitamin E is weaker. In our view, the fundamental culprit for the asthma epidemic—and for the epidemic of all autoimmune diseases (Th1 and Th2)—is vitamin D deficiency due to a decrease in sun exposure which can probably be remedied only by supplementation of pregnant women. However, in their most recent paper published in this issue of Thorax, Willers and coworkers24 report the importance of a decline in the intake of fresh fruits and vegetables and perhaps oily fish consumption with regard to asthma, and it seems plausible that maternal dietary deficiencies of vitamin E are contributing to the epidemic of autoimmune disease as well (see page 773). Certainly, given the available data, randomised controlled trials of vitamin E in pregnant women are indicated.

Given these important results, what needs to be done next? First, measurement of actual vitamin D levels during pregnancy and in cord blood and determining their relationship to subsequent wheezing in birth cohort studies can easily be done. Measuring levels directly, rather than estimating intake from food frequency questionnaires, will be more reliable since levels will integrate sun exposure as well as supplement use to assess exposure accurately. Second, the two confirmatory observational birth cohort studies are enough to suggest an intervention trial of vitamin D supplements to prevent the development of immune-mediated disorders, particularly asthma. Such a trial has currently been submitted for funding and is awaiting review in the USA. While the postnatal effects of vitamin D on immune function are clear, its effects on immune development are not. More needs to be known about the mechanisms by which vitamin D, vitamin E and other nutrients influence fetal development. This is the province of epigenetics and genetic programming of the fetus and should be done in mouse models. In our view, this line of research can have major public health implications that go beyond respiratory disease and influence everything from childhood infection in the Third World to type 1 diabetes and inflammatory bowel disease in industrialised societies.

Vitamin D deficiency is the single most important dietary deficiency in the world today. It has already been linked to prostate cancer, colon cancer and breast cancer. After almost 35 years of increases in allergic and autoimmune disease, we are beginning to understand the causes of the epidemic. Much more research is needed, but the way seems clear to rapidly improve human health in a number of areas once the appropriate studies are done.
Air pollution and health

Air pollution, human health, climate change and you

George Thurston

The “co-benefits” of reducing air pollution on climate change and human health

The study by Ko et al \(^\text{1}\) in this issue of Thorax (see page 780) provides an important new contribution to the growing body of evidence that the severe adverse health effects of air pollution, so well documented in Europe and North America, are also occurring in Asia. Indeed, a recent report by the Health Effects Institute (HEI) surveyed the available published literature on this topic as part of its Public Health and Air Pollution in Asia-Science Access on the Net (PAPA-SAN) study. They found hundreds of published studies showing adverse health effects of air pollution in Asia and summarised the results on the web (http://www.healtheffects.org/Asia/papas-an-home.htm). These results show that a wide range of health effects are significantly associated with air pollution exposures in Asia, including studies of respiratory and cardiovascular morbidity and mortality in a number of cities across Asia. In fact, the HEI report identified 69 published studies of the effects of air pollution on the health of populations in Mainland China, 16 in Hong Kong, 56 in Taiwan, China, 8 in Indonesia, 2 in Malaysia, 6 in Singapore, 13 in Thailand, 30 in India, 46 in Japan and 33 in South Korea. The study by Ko et al \(^\text{1}\) now adds to this knowledge by identifying a susceptible population not studied extensively before in Asia—people suffering from chronic obstructive pulmonary disease, the fifth largest cause of death in Hong Kong. Clearly, there is a large body of studies documenting an ever widening range of adverse health effects of air pollution in Asia. As summarised in the HEI report, the increased cardiopulmonary risks found in Asia are similar in magnitude, per amount of pollution, to the relative risks found in other parts of the world. \(^\text{2}\) But the importance of these increased risks for illness, hospital admissions and mortality are much greater than in Europe or North America because the levels of air pollution in Asia are usually so much higher. For example, the populations of Hong Kong and New York City are both about 8 million, but the annual average concentration of particulates with an aerodynamic diameter <2.5 μm (PM2.5) in Hong Kong, as reported by Ko et al \(^\text{1}\), is nearly triple that found in New York (36 μg/m\(^3\) vs approximately 14 μg/m\(^3\)). And, as shown in fig 1, Hong Kong has among the cleanest air of Asian cities. Air pollution represents a major, and growing, public health problem in Asia. Indeed, the World Health Organisation (WHO) has estimated that urban air pollution contributes each year to approximately 800 000 deaths and 4.6 million lost life-years worldwide. \(^\text{3}\) As the population and economic activity of Asia grows, and as the migration of residents from the rural countryside to the cities accelerates, the outdoor air pollution health problems will continue to worsen unless measures are taken to reduce emissions of air pollutants by industrial, motor vehicle and fossil fuel combustion sources.
Maternal diet vs lack of exposure to sunlight as the cause of the epidemic of asthma, allergies and other autoimmune diseases

Scott T Weiss and Augusto A Litonjua

Thorax 2007 62: 746-748
doi: 10.1136/thx.2007.079707

Updated information and services can be found at:
http://thorax.bmj.com/content/62/9/746

These include:

References
This article cites 21 articles, 10 of which you can access for free at:
http://thorax.bmj.com/content/62/9/746#BIBL

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Topic Collections
Articles on similar topics can be found in the following collections

- Child health (843)
- Asthma (1782)
- Infant health (48)
- Epidemiologic studies (1829)
- TB and other respiratory infections (1273)

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/