A Review of Food Allergy and Asthma

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Abstract

Asthma is a serious public health problem throughout the world, affecting people of all ages. It is a pulmonary disease characterized by reversible airway obstruction, airway inflammation and increased airway responsiveness to a variety of stimuli. Asthma and Allergy are usually associated with early age onset, but may also affect elderly subject. Allergic Bronchial Asthma is caused by exposure to environmental and dietary allergens. Approximately in every fifth asthmatic the possible role of food allergy should be taken into account. Both food allergy and asthma are atopic diseases and therefore frequently co-exist. In the diagnosis of food allergy in asthmatics only clinical history is not sufficient and to date there are no laboratory tests that will confirm or exclude food allergy with certainty. There is a perception amongst the general public that foods are frequently implicated in precipitating exacerbations of asthma. Asthma can trigger off due to various factors so it is important to take control of these factors that may influence a person adversely resulting in the manifestation of the symptoms. Diet is very important in controlling and even correcting certain symptoms. It is extremely important to take care of certain general characteristics and demographic profile of the normal person or patient before planning the diet. The general guidelines to be followed remain very straightforward. It is imperative and always recommended to asthma patients to avoid fried and spicy food and heavy meals especially at night as they may cause coughing, discomfort in breathing and lead to undue pressure on the respiratory system. Asthma patients are advised to concentrate more on eating vegetarian diets rather than non vegetarian diets, frequent and variety in meals, avoid consumption of food additives and excess sweets as it leads to exertion on the system which may cause trouble in breathing.

Their diet needs to be balanced for vitamins and minerals so that no extra supplements are needed by the body, but degree of severity increases the requirement. As regular pattern of a healthy and wholesome breakfast, nutritious lunch and light dinner is very important to be followed, the effect of medication on diet (drug and diet interaction) should be regularly monitored so that they may not trigger off any other serious side effects. However, diet is a complex combination of foods from various groups and nutrients, and some nutrients are highly correlated. It would be challenging to separate the effect of a single nutrient or food group from that of others in free-living populations

Keywords: Asthma, Food Allergy, Nutrients, Dietary allergens, Food items, Dietary pattern
Introduction

Asthma is a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role. The chronic inflammation causes an associated increase in airway hyper-responsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness and coughing particularly at night or in the early morning. These episodes are associated widespread but variable outflow obstruction that is often reversible either spontaneously or with treatment.\(^1\) Worldwide, asthma affects approximately 300 million people, and this number is expected to reach 400 million by 2050.\(^2\) Based on the application of standardized methods, the prevalence of asthma and wheezing is increasing in children and adults.\(^4\) In India also there is a vast elevation in increase in the number of people with asthma in last ten years\(^5\). There are also worldwide disparities in asthma mortality, which is most common in low to middle income countries.\(^6,7\) The causes of this global asthma epidemic are largely unidentified; they are probably multifactorial and might include changes in diet—eg, decreased consumption of fruits and vegetables and increased intake of refined grains, red meats, and saturated fats.\(^8\)

Allergies play a major role in conditions such as asthma. Allergens can lead to asthmatic symptoms, caused by narrowing of the airways (bronchoconstriction) and increased production of mucus in the lungs, shortness of breath (dyspnea), coughing and wheezing. Asthma and Allergy are usually associated with early age onset,\(^6,9\) but may also affect elderly subject, and the diagnosis of these diseases is challenging due to coexisting disorders and underreporting of symptoms. Considering both food allergy and asthma together, approximately one third of children with food allergy have asthma\(^10\) and 4–8% of children with asthma have food allergies\(^11\)

The public perception\(^12\) of the role of food allergy in asthma control is different from what has been proven in laboratory and medical studies.\(^13\) A meta-analysis determined that diet plays an important role in asthma\(^14\) Investigators have looked at the role of diet in the aetiology of asthma.\(^15,16,17,18,19\) The authors concluded that in adults in the USA the most common allergens are shellfish (2%), peanut (0.6%), tree nuts (0.5%), and fish (0.4%) in males\(^20\) and females\(^21\). In addition to these foods, the studies show that Adherence to the Mediterranean type of diet is associated with lower prevalence of asthma symptoms\(^22\) and also there is more Risk of asthma due to high intake of calories but nutrient-poor dietary pattern\(^23\) A more rigorous scientific approach used in the Shaheen\(^24\) and Miyake\(^25\) studies may explain differences between their outcomes and those reported by Lange\(^26\) Previous studies on the relationship of diet and nutrition with asthma have focused on either individual nutrients\(^17,18\) (eg, long-chain polyunsaturated fatty acids, vitamin D, and antioxidants) or individual food groups\(^15,19\) (eg, fruit, vegetables, and fish). However, diet is a complex combination of foods from various groups and nutrients, and some nutrients are highly correlated. It would be challenging to separate the effect of a single nutrient or food group from that of others in free-living populations.
**Vitamins and Minerals**

Vitamin-C is the most extensively investigated among antioxidants and has been shown to be associated with a reduced risk of asthma. Supplementation with vitamin-C has been shown to decrease asthma severity and frequency. Moreover, vitamin-C reduces the duration of episodes and the severity of symptoms of the common cold. Natural sources of vitamin-C are citrus fruits and red and yellow pepper. Vitamin E comprises several fat-soluble components with distinct antioxidant properties. Vitamin-E effects have been studied and there is evidence of beneficial effects of vitamin-E on asthma. High vitamin-E intake is associated with reduced asthma incidence. Vitamin-A have protective effect in asthma. Vitamin-A derivatives of retinol influence the development, maintenance, differentiation, and regeneration of lung epithelial cells and may play a central role in the development of airway disease. Various studies have investigated the difference in vitamin D levels between asthmatic and non-asthmatic children. It is reported that relatively less incidence of asthma exacerbation is observed in asthmatic children taking vitamin D supplements. Accordingly, further studies are needed to reveal such causal relationship as may exist and to suggest treatments. Asthmatics are typically deficient in vitamin- B12, choline and folic acid and supplementing these subjects can help to reduce asthma symptoms.

Among minerals, selenium has been most strongly associated with asthma. Studies have demonstrated decreased selenium intake and decrease serum levels in patients with asthma. Selenium deficiency may greatly increase the risk of asthma. Selenium functions as a cofactor for the antioxidant enzyme glutathione peroxidase, which is proposed to counter oxidation and to reduce the synthesis and release of leukotriene B4, an inflammatory mediator. There is also strong evidence of protection by dietary magnesium against asthma. Magnesium has several biological effects of potential relevance to asthma, including bronchodilatation when given intravenously in acute severe asthma. Bronchial reactivity appears to increase with greater salt intake. Studies have linked increasing dietary salt intake with worsening asthma symptoms and increased bronchodilators use. Research suggests that the effects of sodium are limited to individuals with asthma. Dietary sodium may increase airway reactivity and cause bronchoconstriction through potentiation of the electrogenic sodium pump in the membrane of the airway smooth muscles. There are evidences linking copper, zinc and manganese with asthma. Copper and Zinc have role in antioxidant defense as cofactor in superoxide dismutase. Zinc is an essential trace mineral for most immune mechanisms in the body to function, including lymphocyte (T-cell) function. Zinc deficiency may also lead to an enhanced Th2 immune response. Manganese has been found deficient in bronchial biopsies of asthmatic patients, indicating manganese replenishment could help in treatment of asthma.

**Anti Oxidants**

The epithelial lining of the respiratory system, by virtue of its large surface area and its role in gas exchange and host defense, is vulnerable to oxidant damage. The toxicity of oxidants which are directly inhaled such as cigarette smoke and air-pollution or generated through inflammatory process such as in response to allergen and viral infection, is normally balanced by the protective activity of an array of endogenous antioxidant defense system which may be functionally dependent on adequate supply of nutritional antioxidants. Asthma is, therefore, also associated with...
oxidative-antioxidative imbalance. Antioxidant status may affect asthma risk by influencing the development of the asthmatic immune phenotype, the asthmatic response to antigen provocation, or the inflammatory response during and after an asthma attack.\textsuperscript{47, 48, 49}

**Role of Fatty Acids**

Dietary fatty acids have important role in asthma.\textsuperscript{50, 51, 52} Fish oil may alleviate certain inflammatory respiratory diseases preserve normal airway resistance and modulate allergic sensitization\textsuperscript{53}. There is also some evidence that the balance of the unsaturated fatty acids in diet may act directly to influence gene expression. Sources of omega-3 fatty acids are fish oil, fish, shellfish and leafy vegetables. Sources of omega-6 fatty acids are vegetable fats such as margarine and processed foods.

**Amino Acids**

Among amino acids, of particular interest are the amino acids: cystine,\textsuperscript{54} methionine,\textsuperscript{55} glycine and glutamic acid,\textsuperscript{56} which collectively contribute to glutathione metabolism. Studies have drawn attention to amino acids\textsuperscript{57, 58} where the metabolic pathways may differ in asthmatic subjects as compared to control subjects. It is therefore, possible that changes in the pattern of amino acids intake arising from an overall increase in the proportion of protein from animal sources may have contributed to the rise in asthma prevalence that has occurred in the most developed countries.

**Fruits and Vegetables**

High intake of fruits is associated with a reduced risk of asthma. Several studies have demonstrated a reduced risk of asthma in relation to a high fruit intake.\textsuperscript{53} In a study, it was suggested that eating vegetables and fruits are protective for asthma/wheeze. Fruits and vegetables are better than vitamins pills.\textsuperscript{59} In a study it was found that daily intake of fruits and vegetables in infancy decrease the risk of asthma more than that by the intake of extra vitamins and cod liver oil supplements.\textsuperscript{60} This may be explained by the fact that more fruits are high in vitamin-C, which may be more important dietary antioxidant. One of the most effective methods of exploiting that effect to individual and population benefit is probably dietary manipulation to increase the intake of natural foods and particularly fresh fruits and vegetables.

**Common food items as potent allergens are** \textsuperscript{61}:

**Fast Food:** It has been found that intake of fast foods is associated with increased risk of asthma in children. In a study, eating at fast food outlets was a significant risk factor for asthma as were the lowest intake of milk, vegetables and of fibers.

**Egg:** Egg is one of the most allergenic of all foods, and minute amounts of egg can result in asthma symptoms within minutes, including anaphylaxis. This is also seen after contact with egg through non-oral routes.
Milk: Patients with very sensitive milk allergy can react to a very small quantity of milk protein, including minor contamination, and even inhalation of milk powder and present with asthma.

Soy: Because of the almost unlimited uses of soy, it is an insidious hidden allergen. As with other allergens, soy protein may cause asthma symptoms and anaphylaxis.

Wheat: Wheat is the most allergenic of all cereals. Ig E antibodies have been demonstrated to many components of wheat. Wheat is most rich in gluten, with the other grains containing a lesser mixture of gluten and gliadin. For the wheat hypersensitive individual, products made from oats, rice, rye, barley or corn may be used. However, cross reactions, although unusual, may occur between wheat and these cereals.

Peanuts: Peanuts are one of the most allergenic foods and peanut allergy is one of the most common food allergies. It can cause asthma and anaphylaxis leading to death in many cases.

Fish: Though fish oils have beneficial role in asthma, fish is one of the common causes of food allergy. It is generally recommended that patients allergic to fish should avoid all fish species.

Dietary factors associated with asthma are:

Diet during pregnancy/Prenatal diet and asthma: The diet during pregnancy is the most important than at any other point in life. The relationship between a mother’s diet during pregnancy and the child’s subsequent risk of developing asthma or atopy has become a topic of growing investigation. Reduced maternal intake of vitamin E, vitamin D, and zinc during pregnancy all have been associated with a greater risk of development of asthma and wheezing symptoms in children. With exciting developments elucidating the relationship between the in utero environment and subsequent onset of complex diseases, there is further motivation to explore the impact of diet on fetal development and risk of asthma. Moreover, such a diet may have an adverse effect on maternal and/or fetal nutrition. So it is recommended to cease strict elimination diets during pregnancy.

Probiotics and intestinal microbiota: Probiotics are dietary supplements that contain beneficial bacteria such as Lactobacillus GG and may be effective in preventing early atopy in children through the modulation of intestinal microbiota. It has been suggested that promotion of Lactobacillus and other potentially beneficial gut microorganisms may protect against the development of atopic disease. Breast feeding promotes gut colonization with bifidobacterium, and thus reduces chances of atopy and/or asthma. Probiotics may enhance IgA responses in the gut as well as regulate inflammatory cytokines, both immunomodulatory effects that could prevent progression of atopy and potentially development of disease. A study, is required before any recommendations can be given about probiotic administration for asthma prevention.
Breastfeeding: The human gastrointestinal tract is sterile at birth, rapidly undergoing colonization of the gut with subsequent development of the immune system. Breastfeeding is well known to modify the intestinal composition of commensal bacteria, which drives immune development in the infant. Instead, breastfed infants had the most potentially beneficial intestinal microbiota.

Westernized diet: The westernized diet that had preceded and paralleled the increase in asthma and atopic disease. It is observed that there had been a decrease in vegetable consumption, particularly of potatoes and green vegetables, and also decreased antioxidants intake had increased population susceptibility with consequent large increases in the prevalence of asthma and allergy. Studies have shown that fruit and vegetable consumption remains low despite public health efforts to improve overall diet quality. It is postulated that decreased dietary antioxidant intake leads to reduced antioxidant defenses in the lung, leading to increased oxidative stress with increased susceptibility to airway inflammation and asthma. Aside from antioxidants, intake of fats, particularly the changing composition of polyunsaturated fatty acids (PUFAs) in western diets, has been implicated in asthma.

Mediterranean diet: The great antioxidant support provided by fresh fruits and vegetables is very likely to be a major source of lung and airway support in a Mediterranean-diet approach, and so is the rich array of anti-inflammatory compounds found in signature foods like extra virgin olive oil. While it's not surprising to see the Mediterranean diet providing clear benefits in the case of asthma, it's encouraging to see these study results pointing so clearly in a favorable direction.

Obesity: Obesity, as defined by a body mass index (BMI) of 30 or higher, and asthma are also thought to be linked by inflammation. Researchers have found that obese asthmatics have more chronic low-grade systemic inflammation, meaning that they suffer from inflammation that affects the whole body. As obese patients have this inflammation obese patients are more likely to be asthmatic. The association between the obesity and asthma can be striking, several studies have shown that obese children and teenagers were twice as likely to have asthma as children at a healthier body weight. There are studies that suggest that physiologically, obesity can cause asthma, it's because in obese people their lungs are under-expanded, therefore they take smaller breaths making their lung airways more narrow and prone to irritation. It has been long recognized that airway swelling and inflammation help to trigger asthma attacks.

Conclusion: Asthma and Food allergy are usually associated with early age onset, but may also affect elderly subject, and the diagnosis of these diseases is challenging due to coexisting disorders and underreporting of symptoms. However, diet is a complex combination of foods from various groups and nutrients, and some nutrients are highly correlated. It would be challenging to separate the effect of a single nutrient or food group from that of others in free-living populations. Despite various reports of improvement in bronchial reactivity there is no conclusive evidence of improvement in asthma with dietary control. Therefore, apart from allergen avoidance in patients with documented IgE-mediated food allergies currently there are no recommendations to avoid any foods in the treatment of asthma.
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