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Nutritional Recommendations in Asthmatic Patients

Marzie Zilaei and Seyed Ahmad Hosseini

Abstract

Asthma is a heterogeneous disease, and airway inflammation has an important role in its pathogenesis. Some nutritional factors can influence the process of asthma. It is reported that saffron has anti-inflammatory, antioxidant, and muscle relaxant effects, and some animal and human studies showed that saffron and its active components (safranal and crocin) improved the asthma biomarkers and clinical symptoms. Some other nutritional factors also affect asthma; for example, magnesium can relax the muscles and thus has bronchodilatory effects. Curcumin is the major active component of turmeric which has a potent antioxidant, anti-inflammatory, and anti-allergic effects. Because some researchers suggested that intestinal microbial flora has an important role in allergy, probiotics can be a complementary supplement for asthmatic patients. Generally nutritional factors could be advised for asthmatic patients with the goal of reducing the needs for chemical drugs.

Keywords: asthma, inflammation, spirometry, nutritional recommendations

1. Introduction

Asthma is usually associated with chronic inflammation of airway [1]. In asthmatic patients, bronchial hyper-responsiveness, airway inflammation, and also airway remodeling are the prominent features. This chronic respiratory disease affects over 300 million people worldwide, and it is estimated that it will probably become more than 400 million by 2020 [2]. The WHO has estimated that 15 million disability-adjusted life-years are lost annually due to asthma [3]. Asthma disease imposes many economic and social burdens [4].

Nutritional advices have an important role in the improvement of lung function of asthmatic patients.

2. Saffron and asthma

Saffron (*Crocus sativus* L.) has antioxidant [5], anti-inflammatory [6], and muscle relaxant effects [7] and so has beneficial effects on asthma. Results of our clinical trial showed that saffron supplementation (100 mg of dried saffron stigma in capsules) for 8 weeks in mild and moderate allergic asthmatic patients improved the lung function by increasing the forced expiratory volume in 1 second (FEV₁), forced vital capacity (FVC), FEV₁/FVC ratio, and forced expiratory flow (FEF)₂₅₋₇₅ and decreased some inflammatory factors (anti-HSP 70 and hs-CRP) in comparison to placebo [8]. In this trial the clinical symptoms of patients (including

frequency of the shortness of breath during day- and nighttime, use of salbutamol spray, waking up due to asthma symptoms, and activity limitation) improved after saffron supplementation [9].

Some animal studies also investigated the effects of saffron on asthma. Active constituents of saffron (safranal and crocin) have antioxidant and anti-inflammatory effects and so have beneficial effects on asthma. This is reported that saffron supplementation in animals with allergic asthma decreased eosinophils, basophils, and total white blood cells, and some of these effects were found to be equal to dexamethasone [10]. Saffron supplementation in guinea pig with allergic asthma decreased the serum level of endothelin1 (as an inflammatory index) [11]. Boskabady et al. reported that saffron had a potent relaxant effect on tracheal chains of guinea pigs which was comparable to or even higher than that of theophylline [7].

3. Magnesium and asthma

Insufficient magnesium (Mg) intake can influence the management of asthma [12, 13]. Some drugs used in the treatment of asthma reduce the body's magnesium storage [14]. For example, β_2 -receptor agonist drugs can increase urinary excretion of magnesium and thus lead to magnesium deficiency [15].

Magnesium has muscle relaxant effects and bronchodilator effects [16] because of physiologic calcium antagonist effects [17] or adenylyl cyclase activation action [18]. Results of a clinical trial on 112 patients with mild to moderate asthma suggested that 340 mg MgSO_4 supplementation for 2 months had bronchodilation effects and improved the lung function and so can be used as an emergency treatment for asthma attack [19].

Alexandra et al. [20] surveyed the effect of magnesium in patients with mild to moderate asthma. They showed that 340 mg Mg supplementation for 6.5 months significantly increased the concentration of methacholine required to cause 20% drop in the forced expiratory volume in 1 minute (FEV1) and improved the peak expiratory flow rate (PEFR). Mg also improved the quality of life and asthma control in comparison to control group [20].

For children with moderate-to-severe asthma, magnesium seems to be beneficial. It is a safe drug to prescribe but has minor side effects reported, for example, pain and numbness at the infusion site, hypotension, epigastric or facial warmth, flushing, dry mouth, and malaise. Due to the anti-inflammatory and bronchodilating effects, magnesium can be considered as an adjuvant therapy in pediatric patients who do not respond to conventional treatment in severe manifestations of asthma. Future studies should investigate the best route of administration and the optimal dosage for most benefits [21].

Because of the difficulties in measurement and also interpretation of extracellular vs. intracellular forms of magnesium, the relationship between asthma and magnesium deficiency is unclear [15]. Some studies reported that low dietary magnesium intake (which is the major determinant in homeostasis of magnesium) may be involved in the etiology of chronic obstructive airway disease and asthma [15]. Britton et al. reported that 100 mg/d higher dietary magnesium intake was independently associated with higher FEV1 and lower bronchial hyperreactivity [22].

4. Curcumin and asthma

Curcumin is the yellow pigment of turmeric (*Curcuma longa*) (a spice) which has anti-inflammatory [23] and anti-allergic [24] and antiasthmatic [24] effects.

In a murine model of chronic asthma, it is reported that curcumin similar to dexamethasone improved histological changes of chronic asthma [23]. Subhashini et al. reported that curcumin via intranasal route in asthmatic mice suppressed airway inflammation [24]. So, curcumin as a complementary drug in the nasal drop form (without systemic side effects) for local use can be produced.

Chauhan et al. [25] reported that in murines with chronic asthma, curcumin (without any side effects) reduced airway inflammation and remodeling. It decreased IgE, TNF- α , and Th2 responses and increased Th1 route (as a protective response) [25].

In a clinical trial, curcumin supplementation (1000 mg twice a day) in atopic asthmatic patients has no significant effect on FEV1, serum immunoglobulin E, dose of bronchodilator consumption, and asthma control in comparison to placebo [26].

Some anti-inflammatory mechanisms of curcumin include regulation of nuclear factor κ B (NF- κ B) (as a transcription factor), cytokines (TNF- α and IL-6), and adenosine molecules (ICAM-1) [27].

5. Macro- and micronutrients and other nutritional factors and asthma

Oxidative stress has an important role in the progress of asthma. There are some potent evidences that the oxidant-to-antioxidant ratio reduces in asthmatic patients. Oxygen and nitrogen active species have primary effect on the airway inflammation and are indicators of asthma severity [28]. So, supplementation of antioxidants in asthma has some beneficial effects on the progression and severity of disease. It seems that a diet rich in monounsaturated fats and antioxidants that counteract the oxidative stress has a protective effect in children with asthma [29].

It is suggested that antioxidant supplementation can modulate the effects of airway injury in asthmatic patients who are exposed to air pollutants such as ozone. A clinical trial in Mexico City showed that supplementation of vitamins C and E in children with moderate-to-severe asthma reduced the loss of airway function [30].

Studies have also associated selenium deficiency with asthma [31]. A reverse relationship was seen between wheezing symptoms and insufficient vitamin E intake, but the association between asthma and vitamin E was not seen. Thus more studies must be done to understand the mechanism of vitamin E in the oxidation and inflammation of asthmatic patients [32, 33]. Nuts contain selenium and vitamin E and thus are a good choice for asthmatic patients [34].

It is reported that there is an association between asthma and low serum levels of carotenoids. Supplementation of omega-3 polyunsaturated fatty acids of fish oil in asthmatic children decreased the wheezing, but into later childhood this beneficial effect did not continue. It is reported that supplementation of zinc and vitamin C also improves the lung function and asthma symptoms [29].

Conflicting results on the benefits of vitamin D supplementation have been reported. In one study low serum levels (less than 30 ng/dL) of vitamin D were related to an increase in exacerbation of asthma [35]. In another study, high doses of vitamin D supplementation were not associated with any protective effect [36].

Children with a higher than desirable body mass index (BMI) have a significant increase in the risk of development of asthma. In obese children with asthma, weight loss diets showed improvements in the lung function, control of asthma, and quality of life [37]. The effectiveness of inhaled corticosteroid drugs is low in overweight and obese asthmatic patients [38].

The nutritionists should train the overweight and obese patients about the role of weight management in asthma control, discuss about suitable energy intake and activity, and review the known food allergies. Also the nutritionist should provide

high-quality protein, vitamins, and minerals in the form of small meals to reduce the risk of infection [34].

Exposure to food allergens, especially an immunoglobulin E-mediated reaction to a food protein, can cause bronchoconstriction. Complete removal of the allergenic food protein is the only dietary advice which is currently available for food allergies. Some sulfites, such as sodium and potassium sulfides (in processed foods), have been found to be a trigger for patients with asthma [39]. Some common food allergens for children include eggs, milk, seafood, peanuts, tree nuts, fish, soy, or wheat and for adults include peanuts, tree nuts, shellfish, and fish [34].

Percentage of energy intake from fat in asthmatic patients must be high, because the respiratory quotient (RQ) of fats is lower than carbohydrate and protein [33].

Prostanoid production may be affected by dietary fat composition. Observational studies (from the 1960s and 1970s) reported that in population whose diets were rich in fish oil, the incidence of asthma was low [40]. Some studies demonstrated the fish oil anti-inflammatory effects (reduced leukocyte chemotaxis and leukotriene production) in asthmatic patients [41], but results of a systematic review showed that there is no consistent effect of fish oil on lung function, asthma medication use, bronchial hyperreactivity, and asthma symptoms [40]. A review covering 26 studies (randomized, placebo-controlled, and others) reported that the effect of w-3 fatty acid supplements could not be conclusive [42].

When the immune system of infants is immature, breastfeeding protects the immunological system and in early childhood provides a modest protective effect from wheeze [43, 44]. If the duration of breastfeeding could be longer, the protective effects seem to be more. Supplementation the diet of lactating women with fish oil could be related with alteration in the immune response of neonates to allergens, and insufficient intake of zinc and vitamins D and E during pregnancy is related to increased wheezing and asthma in children up to age of 5 years old [45]. Maternal intake of vitamins E and D can modify the development of the lung of neonates [45]. It is reported that insufficient serum level of vitamin D is an index for severity of asthma in childhood [46].

Theobromine in cocoa leads to increase blood flow to the brain and so reduces coughing and is a good food choice for asthmatic patients. It is better that these patients consume less sodium in their diet. In 5–20% of asthmatics patients who are sensitive to aspirin, salicylate sensitivity is common. Some vegetables and many fruits contain salicylates. Quercetin in pears, apples, onions, berries, and oranges should be encouraged in an amount of five or more servings per week [34].

6. Botanicals, herbs, and supplements

- ASHMI, a combination of three herbal extracts (*Ganoderma lucidum* (fungal), *Sophora flavescens*, and *Glycyrrhiza uralensis* (Fabaceae species)), is used in China for antiasthma intervention [47], and in oriental cultures and Vietnam, the seaweed is used [48].
- Gamma linolenic acid (GLA; borage oil) as a dietary fatty acid without any side effects can modulate the endogenous inflammatory mediators [49].
- *Ephedra* has bronchodilator effects, but it has some side effects such as significantly increasing blood pressure and heart rate, arrhythmias, and problems with blood glucose. This has been removed from the market by the Food and Drug Administration (FDA), but some forms are available.

- Licorice, stinging nettle, ginkgo, and anise have not shown efficacy, and side effects of these should be evaluated [34].
- *Boswellia serrata* extract has anti-inflammatory effects due to the triterpene compounds [50]. The mechanism of anti-inflammatory properties of boswellic acids is inhibition of proteases (cathepsin G), lipoxygenases (enzyme which is responsible for the synthesis of leukotrienes), and NF-kB [51].

7. Probiotics and asthma

It is reported that the intestinal flora can affect the mucosal immunity and so may be an effective factor for allergic disease [52]. Exposure to microbial flora in early childhood can lead to a change in the Th1/Th2 ratio toward the Th1 response.

Some studies suggested that the content of intestinal flora can be different in patients with allergic disease and also in individuals who live in industrialized countries (where the prevalence of allergic disease is higher) [53–55]; patients with allergic disease have less Bifidobacteria and Lactobacilli and more Clostridia and Staphylococcus aureu [56, 57].

The World Allergy Organization in 2015 recommended the use of probiotics for prevention of allergy in:

- a. Pregnant women who have children with high risk of allergy
- b. Mothers lactating infants with high risk of developing allergy
- c. Infants who have risk of progressing allergies [58]

Results of a meta-analysis demonstrated that there is no evidence for protective effect of perinatal probiotic administration and childhood wheeze or asthma. So there is insufficient evidence for supplementation of probiotics for the prevention of allergic disorders and asthma, and more studies are required to explore the potential relationship between probiotic and asthma [59].

Generally, probiotic consumption for prevention of asthma and allergy is based on the little evidences, and more studies are needed for exact evaluation of the role of microflora in allergic disease and for determination of the best type of probiotic for supplementation in allergic disease [60].

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