



South African Family Practice

ISSN: 2078-6190 (Print) 2078-6204 (Online) Journal homepage: <http://www.tandfonline.com/loi/ojfp20>

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To cite this article: Irene L Labuschagne & Evette van Niekerk (2016) Diet and childhood asthma: review, South African Family Practice, 58:sup1, S9-S11, DOI: [10.1080/20786190.2014.978098](https://doi.org/10.1080/20786190.2014.978098)

To link to this article: <http://dx.doi.org/10.1080/20786190.2014.978098>



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Published online: 18 Feb 2015.



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Diet and childhood asthma: review

Irene L Labuschagne^{a*} and Evette van Niekerk^b

^a Faculty of Medicine and Health Sciences, Stellenbosch University, Stellenbosch, South Africa

^b Faculty of Medicine and Health Sciences, University of Stellenbosch, Stellenbosch, South Africa

*Corresponding author, email: irene@sun.ac.za

Childhood asthma is the most common chronic inflammatory childhood disease with almost 20% children and adolescents reporting asthma symptoms in South Africa. Associations between asthma and dietary antioxidants (vitamin E, vitamin C, carotenoids, selenium, polyphenols, and fruit), polyunsaturated fatty acids (PUFA), and vitamin D have been found. Adherence to the Mediterranean diet seems protective. This condensed review briefly reports on available data of possible protective dietary patterns and practices.

Keywords: asthma, child, dietary patterns, diet, nutrients

Introduction

Paediatric asthma has rapidly increased over the past 20 years and is the most common chronic inflammatory childhood disease with almost 20% children and adolescents reporting asthma symptoms in South Africa.^{1,2} In two recent surveys of schoolchildren the prevalence of asthma was approximately 12% amongst children aged 6–11, and South Africa ranked 25th among the 93 countries surveyed.³ The rapid increase in asthma is most likely to be a consequence of changing environmental/lifestyle rather than genetic influences. It has been hypothesised that the increase may be due to changing antioxidant intake, increasing dietary ratio of *n*-6:*n*-3 polyunsaturated fatty acids (PUFA), and vitamin D deficiency (and supplementation).⁴

Early life influences

Some studies have documented the importance of exclusive breastfeeding in protecting against development of asthma, but evidence to the contrary also exists.⁵ A prospective birth cohort study in West Australia showed that the risk of childhood asthma aged six years, was significantly reduced if exclusive breastfeeding was continued for at least the first four months of life.⁶ A report from South Africa suggests a protective effect of prolonged breastfeeding on the development of allergic disease, particularly hay fever, in children born to non-allergic parents. This protective effect was not found in children with an allergic predisposition and the protective role of exclusive breastfeeding against asthma was not demonstrated in this study population from a developing country.⁷ Studies in the industrialised nations have shown that the role of breastfeeding in prevention of asthma mainly applies to children with genetic susceptibility to asthma such as those with asthmatic mothers, rather than the general population.^{8–10}

Recently, it has been suggested that high doses of folic acid supplementation during pregnancy has been reported to increase the risk of children's asthma and wheezing.¹¹ Vitamin D plays an important role in normal fetal lung and immune system development and there is increasing speculation that maternal vitamin D status in pregnancy might be linked to the development of asthma and atopy in the offspring. However results from the largest study to date suggest the absence of a clinically important association between maternal 25(OH)D and offspring respiratory health or atopy.¹²

The microflora hypothesis of allergic disease has also been proposed to explain the rising incidence of asthma and other allergic disorders. However a Cochrane review of early life probiotics for prevention of allergic diseases reported no benefit for asthma prevention after probiotic supplementation.^{13,14}

The impact of antioxidants and specific nutrients

Antioxidants

Many features of asthma are induced by the oxidant-caused release of pro-inflammatory mediators. Changes in dietary patterns and more specifically the changes in the consumption of antioxidant-rich foods, have been linked to the increase in asthma and allergic disease.^{15,16} Two hypotheses relate the increase in asthma to changing dietary antioxidant intake. The first proposes that the increase is a consequence of declining dietary antioxidant intake.¹⁷ Studies have reported beneficial associations between a higher consumption of fruit and vegetable consumption.^{18–20} Nakamura et al's findings support the hypothesis that higher dietary intakes of vitamins C and E are associated with a reduced risk of childhood asthma.²¹ It is hypothesised that one possible explanation for decreased antioxidant intakes is associated with the transition from a traditional diet comprising of foods produced and marketed locally and eaten shortly after harvesting to the modern diet dominated by foods that have been processed, stored, and transported great distances. It is suggested that the mineral content of vegetables, fruit, and meat has declined during these processes.⁴

Epidemiologic evidence in relation to nutrients and dietary factors for the prevention of asthma and allergic disorders is overall weak but suggestive in relation to vitamins A and E; zinc, particularly in relation to asthma outcomes. The evidence is less encouraging in relation to vitamin C and selenium.²² From the available intervention data it appears fairly clear that the supplementation of the diets of adults with vitamin C, vitamin E, selenium, and *n*-3 PUFA-rich fish oil²³ has minimal, if any, clinical benefit in established asthma.²³

There are conflicting reports about the benefits of zinc supplements in childhood asthma. Ghaffari et al.²⁴ did a randomised, placebo-controlled trial in the northern Islamic Republic of Iran to investigate the efficacy of zinc supplementation in children with asthma. A total of 248 children on inhaled steroids were allocated to receive zinc supplements (50 mg/day). There

were no significant differences in IgE levels before and after treatment. The case group showed significant improvements in clinical symptoms such as cough, wheezing and dyspnoea and in all spirometry parameters.

The second antioxidant hypothesis proposes that the increase in asthma and allergic disease is a consequence of increased antioxidant intake because of the increased availability of functional and antioxidant-enriched foods.²⁵ *In vitro* observational studies show that some antioxidant-rich foods suppress the secretion of the Th1 cytokine interferon- γ . It is postulated that increased antioxidant intake by suppressing Th1 differentiation promotes Th2 differentiation because of inherent cross-regulatory mechanisms.²⁵

A Mediterranean-style diet has been associated with a reduced likelihood of asthma and wheezing in children.²² Saadeh et al. reviewed five cross-sectional studies and one review article which all found that the adherence to the Mediterranean diet was inversely related with atopy in children.² Adherence to the Mediterranean diet, and following a healthy dietary pattern by eating more vegetables and fruits, for example, has been shown to be a protective factor for atopic diseases in children in many countries such as Sweden, Greece, and Mexico.^{26–28} In addition, a high level of adherence to the Mediterranean diet was a protective factor for current wheezing in children.²⁹

Arvaniti et al.²⁸ recently studied adherence to the Mediterranean diet in Athens in children aged 10–12 years in relation to wheezing and asthma symptoms. They found that a high level of adherence to the Mediterranean diet had a protective effect on asthma symptoms. Dietary habits were evaluated by an FFQ completed by the children and their parents through face-to-face interviews, and a special diet score, the KIDMED score, was calculated to evaluate adherence to the Mediterranean diet. Higher KIDMED scores corresponded to greater adherence to the diet. There was a lack of association between single foods and asthma prevalence, but the overall results suggested a protective effect of a high level of adherence to the Mediterranean diet on asthma symptoms.³⁰

Vitamin D

It was proposed that at the increase in allergy and asthma is a consequence of widespread vitamin D insufficiency and cited immunological reports of vitamin D promoting regulatory T-cell function and consequent inhibition of Th2 differentiation.^{31,32} Research suggests that vitamin D insufficiency is relatively frequent in children with asthma. Also lower vitamin D levels are associated with increased markers of allergy and asthma severity.³³

PUFA intake

Long-chain *n*-3 PUFA such as eicosapentaenoic acid and docosahexaenoic acid that are present in fresh oily fish (e.g. fresh tuna, herring, mackerel, trout, and salmon) or derived fish oil products (cod liver oil).⁴ The combination of decreasing *n*-3 and increasing *n*-6 PUFA intakes has contributed to the increase in allergic disease and consequently asthma.¹⁰ This increased dietary *n*-6:*n*-3 PUFA ratio renders an inflammatory cell-mediated response associated with asthma symptoms.⁴ Antova et al. found a relationship between respiratory symptoms and low intake of fish. A recent meta-analysis suggested that fish consumption in infants was inversely associated with the incidence of asthma in their childhood.¹⁸

Total energy intakes and obesity

Evidence suggests that obesity complicates the diagnosis, treatment, and course of asthma, whereas significant weight loss results in improved pulmonary status.²³ Ciprandi et al.³⁴ demonstrated that obese children tend to have decreased pulmonary volumes while having more bronchial hyper²³ responsiveness, making them more susceptible to developing asthma symptoms than children who are not obese.

Fast food consumption is considered unhealthy especially for children. It contributes to increasing obesity and can also increase the prevalence of chronic diseases like asthma in children. Recently, respiratory allergic diseases in children such as asthma, wheezing and bronchial hyper-responsiveness have been correlated with the high consumption of fast food, like the frequent consumption of hamburgers, salty-snack eating, and frequent takeaway consumption.^{35,36}

Conclusion

As with other chronic diseases, childhood obesity may be linked to an increase in asthma prevalence. Decreased consumption of fresh fruits, green vegetables, and other dietary sources of antioxidants, seems to explain why the prevalence of asthma and respiratory symptoms are lower in populations with high intake of plant foods. The Mediterranean and vegetarian diets are associated with lower rates of asthma in childhood. There is a lack of association between single foods and asthma prevalence, but dairy, vegetables, fruit and fish, as general healthy foods, should be recommended to pregnant women, infants and children.

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Received: 02-09-2014 Accepted: 19-09-2014