

## « Update on Diet and Asthma »

### Editorial

Asthma is a common chronic disease, affecting 1 in 20 people in the world. Asthma was ranked in the recent Global Burden of Disease as the 28<sup>th</sup> cause of disability-adjusted life years. Asthma is considered to be due to a complicated interplay of genetic and environmental factors.

A frequently-cited possible cause of the asthma epidemic is changes in diet, particularly decreased consumption of fresh fruit and vegetables, and increased consumption of “Western” processed foods. Evidence supporting an etiologic role of diet comes mostly from studies of childhood asthma; diet appears to have little role in the etiology of adult-onset asthma. However, published studies on diet and asthma are very heterogeneous with regard to study design, assessment of the dietary exposure, and assessment of asthma itself, which has several different phenotypes.

Three recent studies provide additional evidence for a potential role of diet on asthma. In a large international study of children and adolescents (Ellwood *et al.*), fast food consumption was positively associated with the symptom prevalence of asthma and severe asthma, whereas a negative association was reported for fruit and vegetable intakes. In another study, Protudjer *et al.* shows that high vegetable intake was negatively associated with allergic asthma and with moderate-to-severe airway hyperresponsiveness. Regarding the role of diet as a disease modifier, a randomized controlled trial conducted by Wood *et al.* concluded that among adults with asthma, increasing dietary antioxidants intakes by a food approach (i.e. increasing the consumption of fruits and vegetables) was associated with clinical asthma improvement, whereas no effect was reported for the supplement approach. Taken together, these studies support the promotion of a diet with high intake of fruit and vegetables, and low intake of fast foods, as a possible method to prevent the development of asthma in children, and improve asthma control in adults with asthma.

Raphaëlle Varraso<sup>1,2</sup> & Carlos A Camargo Jr<sup>3</sup>

1. Inserm, CESP Centre for Research in Epidemiology and Population Health, U1018, Respiratory and Environmental Epidemiology Team,
2. Univ Paris Sud 11, UMRS 1018 F-94807, Villejuif, FRANCE
3. Department of Emergency Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, USA



#### Editorial Board

- E. Bere • University of Agder • Faculty of Health and Sport, Norway
- E. Birlouez • Epistème • Paris, France
- I. Birlouez • INAPG • Paris, France
- MJ. Carlin Amiot • INSERM • Faculté de médecine de la Timone • Marseille, France
- S. Kim • Center for Disease Control and Prevention • Atlanta, USA
- V. Coxam • INRA Clermont Ferrand, France
- N. Darmon • Faculté de Médecine de la Timone, France
- ML. Frelut • Hôpital Saint-Vincent-de-Paul • Paris, France
- T. Gibault • Hôpital Henri Mondor • Hôpital Bichat • Paris, France
- D. Giugliano • University of Naples 2, Italy
- M. Hetherington • University of Leeds, UK
- S. Jebb • MRC Human Nutrition Research • Cambridge, UK
- JM. Lecerf • Institut Pasteur de Lille, France
- J. Lindstrom • National Public Health Institute • Helsinki, Finland
- C. Maffei • University Hospital of Verona, Italy
- A. Naska • Medical School • University of Athens, Greece
- T. Norat Soto • Imperial College London, UK
- J. Pomerleau • European Centre on Health of Societies in Transition, UK
- E. Rock • INRA Clermont Ferrand, France
- M. Schulze • German Institute of Human Nutrition Potsdam Rehbruecke, Nuthetal, Germany
- J. Wardle • Cancer Research UK • Health Behaviour Unit • London, UK

#### IFAVA Contacts info

**HEAD OFFICE**  
International Fruit And Vegetable Alliance  
c/o Canadian Produce Marketing Association  
162 Cleopatra  
Ottawa, Canada, K2G 5X2

**IFAVA CO-CHAIR**  
Paula Dudley - New Zealand  
paula@5aday.co.nz

**IFAVA CO-CHAIR**  
Sue Lewis - Canada  
slewis@cpma.ca

#### Board of Directors

- S. Barnat • Aprifel • France
- L. DiSogra • United Fresh • USA
- P. Dudley • Co-Chair • United Fresh • New Zealand
- S. Lewis • Co-Chair • Fruits and Veggies - Mix it up!™ • Canada
- E. Pivonka • Fruits & Veggies - More Matters • USA
- M. Slagmoolen-Gijze • Groenten Fruit Bureau • Netherlands

#### Scientific Clearing House Committee

- S. Barnat • Aprifel • France
- E. Pivonka • Fruits & Veggies • More Matters • USA
- C. Rowley • Go for 2&5<sup>®</sup> • Horticulture - Australia • Australia



# Do fast foods cause asthma? ISAAC Phase Three findings

Philippa Ellwood, Innes Asher

Department of Paediatrics: Child and Youth Health, University of Auckland, New Zealand

Developed countries have experienced an increase in the symptom prevalence of non-communicable diseases (NCDs) of asthma, rhinitis and eczema in the past few decades<sup>1,2</sup> and as developing countries become more urbanised these diseases appear to be increasing<sup>3-5</sup>. The incidence of many other NCDs has been linked to diet and many developing countries are moving away from the traditional diet of locally grown foods as they become more westernised<sup>6</sup>. Migration and food aid (with increased consumption of processed foods) as well as the increased consumption of fast foods<sup>7,8</sup>, have been associated with the rapid increase in asthma prevalence, suggesting these may bring potent modifiable environmental factors<sup>9</sup>.

## The International Study of Asthma and Allergies in Childhood (ISAAC)

ISAAC is a multi-centre, multi-country, multi-phase cross-sectional study. ISAAC Phase Three involved 13-14 year old adolescents and 6-7 year old children. Schools were chosen randomly from a defined geographical area<sup>10</sup>. Standardised core written questionnaires and an optional environmental questionnaire (EQ) [[www.isaac.auckland.ac.nz](http://www.isaac.auckland.ac.nz)] were used to test specific etiologic hypotheses. Questionnaires on the symptom prevalence of asthma, rhinoconjunctivitis and eczema and types and frequency of food intake over the past 12 months were completed by the adolescents, and by parents/guardians of the children. Prevalence odds ratios (ORs) were estimated using logistic regression, using a random (mixed) effects model. Further multiple regression analyses were conducted to investigate whether associations between symptoms and diet were confounded by other risk factors for which information was collected in the EQ, and which had shown associations with symptoms in the univariate analyses. These were exercise, television watching, maternal education, maternal smoking in the first year of life (children only), and current maternal smoking. Data from 319,196 adolescents from 107 centres in 51 countries, and 181,631 children from 64 centres in 31 countries were included in the analysis.

### Protective foods

#### • Adolescents

For all centres combined, fruit intake once or twice per week and  $\geq 3$  times per week was inversely associated for

current wheeze and severe asthma, as well as current and severe rhinoconjunctivitis and severe eczema once or twice per week. Milk was inversely associated with current wheeze once or twice per week, severe asthma  $\geq 3$  times per week, current and severe rhinoconjunctivitis once or twice per week and current and severe eczema once or twice per week as well as  $\geq 3$  times per week for current eczema. Vegetable consumption was also inversely associated with current wheeze  $\geq 3$  times per week.

#### • Children

For all centres combined, eggs, fruit, meat and milk were inversely associated  $\geq 3$  times per week with all three conditions, current and severe. Cereal  $\geq 3$  times per week was inversely associated with severe asthma. Vegetables once or twice per week and  $\geq 3$  times per week were inversely associated with current and severe wheeze as well as for current and severe rhinoconjunctivitis and  $\geq 3$  times per week with current eczema.

### Risk factor foods

#### • Adolescents

For all centres combined, fast food once or twice per week and  $\geq 3$  times per week was positively associated with current wheeze, and severe asthma,  $\geq 3$  times per week with current rhinoconjunctivitis severe rhinoconjunctivitis and severe eczema.

#### • Children

For all centres combined, fast food once or twice per week and  $\geq 3$  times per week was positively associated with current wheeze and severe asthma. Fast food consumed  $\geq 3$  times per week was positively associated with current and severe rhinoconjunctivitis and severe eczema.

### Conclusion

Our results suggest that the consumption of fast food may be contributing to the increasing prevalence of asthma, rhinoconjunctivitis and eczema in adolescents and children. Fruit showed a slightly smaller but protective effect for the three conditions. For other foods, the picture was less clear. However, in concordance with international dietary recommendations, diets that have a regular consumption of fruit and vegetables are likely to protect against asthma, allergic disease and other non-communicable diseases.

### References

1. ISAAC Steering Committee. Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. *Lancet*. 1998;351(9111):1225-32.
2. Anonymous. Variations in the prevalence of respiratory symptoms, self-reported asthma attacks, and use of asthma medication in the European Community Respiratory Health Survey (ECRHS). *European Respiratory Journal*. 1996;9(4):687-95.
3. Hijazi N, Abalkhail B, Seaton A. Diet and childhood asthma in a society in transition: a study in urban and rural Saudi Arabia. *Thorax*. 2000;55(9):775-9.
4. Asher MI, et al. Worldwide time trends in the prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and eczema in childhood: ISAAC Phases One and Three repeat multicountry cross-sectional surveys. *Lancet*. 2006 26;368(9537):733-43.
5. Beaglehole R, et al. Priority actions for the non-communicable disease crisis. *Lancet*. 2011 Apr 23;377(9775):1438-47.
6. Devereux G. The increase in the prevalence of asthma and allergy: food for thought. *Nature Rev Immunol*. 2006 Nov;Immunology. 6(11):869-74.
7. Robertson CF, ISAAC SC. The association between fast food outlets and the prevalence of symptoms of asthma from the International Study of Asthma and Allergies in Childhood (ISAAC). *European Respiratory Journal*. 1998;12 (Supplement 28):244s.
8. Wickens K, et al. Fast foods - are they a risk factor for asthma? *Allergy*. 2005 Dec;60(12):1537-41.
9. Leung RC, et al. Asthma, allergy and atopy in Asian immigrants in Melbourne. *Medical Journal of Australia*. 1994;161(7):418-25.
10. Ellwood P, et al. The international study of asthma and allergies in childhood (ISAAC): Phase Three rationale and methods. *Int J Tuberc Lung Dis*. 2005;9(1):10-6.

# Low vegetable intake is associated with allergic asthma and moderate-to-severe airway hyperresponsiveness

Jennifer Protudjer and collaborators

University of Manitoba, Manitoba Institute of Child Health, Karolinska Institute, CANADA

Asthma has increased in prevalence in recent decades<sup>1</sup>, and now affects approximately 14% of youth worldwide<sup>2</sup>. Over a similar period, there has been a shift from a traditional or prudent diet, to a western diet. Individual nutrients, and foods<sup>4,5</sup> are often studied as exposures for asthma outcomes, thereby potentially resulting in different conclusions than if diet quality was the exposure<sup>4</sup>. Asthma has many phenotypes. Consideration is warranted to two phenotypes: allergic asthma and non-allergic asthma, as atopy (described below) may influence diet and asthma<sup>7</sup>.

## A study of diet quality and asthma in youth

The study was conducted to determine if diet quality is cross-sectionally associated with asthma amongst youth. Data were collected from youth enrolled in a nested case-control study of the 1995 Manitoba, Canada Birth Cohort Study of Allergy, Genes and the Environment (SAGE)<sup>8</sup>. From responses to a food frequency questionnaire (FFQ) based on the FFQ used in the Nurses' Health Study<sup>9</sup>, and adapted to suit the study, diet quality scores were created based on the Youth Healthy Eating Index (YHEI)<sup>10</sup>. The YHEI includes both a total diet score and component scores, based on recommendations from the United States' Department of Agriculture's Dietary Guidelines for Americans<sup>11</sup> and which are similar to those from Canada's Food Guide to Healthy Eating<sup>12</sup>. Youths' scores were classified as either low or high, with a cut-off at the median.

In the study, 26.2% of youth had asthma, according to pediatric allergists' assessments. Youth were skin prick tested to common allergens to determine atopy status. Youth with asthma were classified as having either allergic asthma (asthma + atopy, n=107) or non-allergic asthma (asthma, no atopy, n=38).

Airway hyperresponsiveness (AHR) was also considered, which is informative in the presence of asthma-like symptoms but the absence of obvious airway obstruction<sup>13</sup>. AHR was classified as mild, or moderate/severe, and compared to non-AHR. Of youth assessed, 44.3% were non-AHR, 23.5% had mild AHR and 32.2% had moderate/severe AHR.

## Diet quality is relatively poor

FFQ were completed by 476/489 youth (mean age 12.6 ± 0.5 years). The median diet score was 33.5/85, which is suggestive of relatively poor diet quality. Component scores for whole grains, vegetables, fruit, dairy, snack foods and

foods were around the 50<sup>th</sup> percentile. Component scores for multivitamin use and fish were very low.

## Diet quality is not statistically significantly associated with asthma, but high vegetable intake protects against allergic asthma

Diet quality and asthma were not statistically significantly associated. With consideration to asthma phenotypes, the results showed that high vegetable intake was associated with ~50% reduced odds of allergic asthma (p<0.02). No such associations were found for total diet quality, or other components and allergic asthma, or between diet quality and non-allergic asthma.

## Diet quality is not statistically significantly associated with AHR, but high vegetable intake protects against moderate/severe AHR

Similar to the results for diet quality and asthma phenotypes, only high vegetable intake was protective against moderate/severe asthma, again by ~50% (p<0.02). No associations were found between diet quality and mild AHR.

## Clinical Implications and Conclusions

Although vegetable intake was associated with reduced odds of allergic asthma and moderate-to-severe AHR, it is too soon to advise patients that high vegetable intake protects against these conditions. Like other youth<sup>14</sup>, youth in the study had relatively poor diet quality. High vegetable intake should be encouraged as it is associated with many other health benefits.



**Based on:** Protudjer JL, Sevenhuysen GP, Ramsey CD, Kozyrskij AL, Becker AB. Low vegetable intake is associated with allergic asthma and moderate-to-severe airway hyperresponsiveness. *Pediatr Pulmonol*. 2012 Dec;47(12):1159-69.

## References

1. Douwes J, et al. Importance of allergy in asthma: an epidemiologic perspective. *Curr Allergy Asthma Rep*. 2011 Oct;11(5):434-44.
2. Lai CK, et al. Global variation in the prevalence and severity of asthma symptoms: phase three of the International Study of Asthma and Allergy in Childhood (ISAAC). *Thorax*. 2009 Jun;64(6):476-83.
3. Popkin BM, et al.. The nutrition transition: worldwide obesity dynamics and their determinants. *Int J Obes Relat Metab Disord*. 2004 Nov;28:S2-S9.
4. Allan K, Devereux G. Diet and asthma: nutrition implications from prevention to treatment. *J Am Diet Assoc*. 2011 Feb;111(2):258-68.
5. Nurmatov U, et al.. Nutrients and foods for the primary prevention of asthma and allergy: systematic review and meta-analysis. *J Allergy Clin Immunol*. 2011 Mar;127(3):724-33.
6. Mertz W. Food nutrients. *J Am Diet Assoc*. 1994; 84:769-70.
7. Chatzi L, et al. Diet, wheeze, and atopy in school children in Menorca, Spain. *Pediatr Allergy Immunol*. 2007 Sep;18:480-5.
8. Kozyrskij AL, et al.. A novel design to investigate the early-life origins of asthma in children (SAGE study). *Allergy*. 2009 Aug;64:1185-93.
9. Willett W. *Nutritional epidemiology*. New York: Oxford University Press;1990.
10. Feskanich D, Rockett HR, Colditz GA. Modifying the healthy eating index to assess diet quality in children and adolescents. *J Am Diet Assoc*. 2004 Sep;104:1375-83.
11. United States Department of Agriculture. My Pyramid. 2005. Available on-line at [www.mypyramid.gov](http://www.mypyramid.gov)
12. Health Canada. Eating well with Canada's Food Guide. 2007. Available on-line at [www.hc-sc.gc.ca](http://www.hc-sc.gc.ca)
13. O'Byrne PM, Inman MD. Airway hyperresponsiveness. *Chest*. 2003Mar;123:411S-416S.
14. Hiza HA, et al.. Diet quality of Americans differs by age, sex, race/ethnicity, income, and education level. *J Acad Nutr Diet*. 2013 Feb;113(2):297-306.



# Increasing fruit and vegetable intake reduces asthma exacerbation risk

Lisa G Wood

Associate Professor, School of Biomedical Science and Pharmacy and Centre for Asthma and Respiratory Disease, University of Newcastle, 2305, NSW, AUSTRALIA

## The burden of asthma is high

Approximately 300 million people worldwide suffer from asthma<sup>1</sup>. The clinical course of the disease includes acute exacerbations, during which a person with asthma will experience a worsening of symptoms and reduced lung function, associated with an increase in airway inflammation. Medical practice guidelines for asthma stipulate that a key aim of treatment is to prevent exacerbations, as they pose the greatest risk to patients, cause most anxiety to patients and their families, cause the greatest stress to health care providers and generate the greatest cost to the health care system<sup>2</sup>. Inhaled glucocorticoids are most commonly used to maintain asthma control and reduce exacerbation risk. However, considering the costs, side effects and non-compliance issues associated with corticosteroid use, non-pharmacological interventions to prevent exacerbations are needed to reduce the burden of disease attributable to asthma.

## Fruit and vegetable intake is linked to lung health:

It has long been recognised that fruit and vegetables are an important component of a healthy diet, as they are low in energy, yet dense in nutrients such as vitamins and minerals, fibre and phytochemicals (eg polyphenols, carotenoids, indoles, isothiocyanates and organosulfur compounds). Epidemiological studies show that fruit and vegetable intake is related to

improved asthma outcomes. For example, fruit intake has been inversely related to wheeze<sup>3</sup> and chronic lung disease onset<sup>4</sup> and positively associated with lung function<sup>5,6</sup>. Tomato-based products, have been inversely associated with asthma onset<sup>7</sup> and vegetables/ vegetable products have been inversely associated with wheeze<sup>8,9</sup> and asthma onset<sup>10</sup>. These epidemiological observations have been extended by conducting two clinical intervention trials in asthma, in which the fruit and vegetable intake was manipulated.



## Manipulating fruit and vegetable consumption in asthma:

In the first study, 22 subjects with asthma were required to withdraw fruit and vegetables from their diet for 10 days. They were able to consume no more than two serves of vegetables and one serve of fruit per day and were also asked to avoid consuming a list of antioxidant-rich foods, such as tea, nuts and red wine. At the end of the 10 day period, airway inflammation had worsened and clinical outcomes, including lung function and asthma control, had worsened<sup>11</sup>. In the second, longer

term study, the effect of a high versus low fruit and vegetable diet in asthmatics was compared. For 14 weeks, 139 asthmatics were randomised to either a high fruit and vegetable diet (more than five serves of vegetables and two serves of fruit per day) or a low fruit and vegetable diet (less than two serves of vegetables and one serve of fruit per day). Adopting these diets led to changes in nutrient intake, with subjects on the low fruit and vegetable diet having lower intakes of fibre, vitamin C and carotenoids. As a result, subjects on the low fruit and vegetable diet were 2.26 times more likely to have an asthma exacerbation than subjects on the high fruit and vegetable diet. At the end of the trial, these subjects had increased systemic and airway inflammation.

## In summary:

These studies have shown that manipulating fruit and vegetable intake modifies asthma symptoms, lung function and exacerbation risk. The 'high' and 'low' fruit and vegetable diets that were used in the study are very relevant to western populations. The high fruit and vegetable diet is equivalent to the dietary recommendation in both Australia<sup>12</sup> and the USA<sup>13</sup>. Conversely, the low fruit and vegetable diet represents the median usual intake for Australian adults<sup>14</sup>. Hence, these studies demonstrate the potential for typical western dietary patterns to contribute to a worsening of asthma. The conclusion is that consumption of a high fruit and vegetable diet may be helpful in the management of asthma.

## References

1. Masoli M, Fabian D, Holt S, Beasley R. Global Initiative for Asthma (GINA) Program: The global burden of asthma: executive summary of the GINA Dissemination Committee report. *Allergy* 2004;59:469-78.
2. Reddel HK, Taylor DR, Bateman ED, Boulet LP, Boushey HA, Busse WW, et al. An official American Thoracic Society/ European Respiratory Society statement: asthma control and exacerbations: standardizing endpoints for clinical asthma trials and clinical practice. *Am J Respir Crit Care Med*. 2009 Jul 1;180(1):59-99.
3. Butland BK, Strachan DP, Anderson HR. Fresh fruit intake and asthma symptoms in young British adults: confounding or effect modification by smoking? *Eur Resp J*. 1999;13:744-50.
4. Miedema I, Feskens EJM, Heederik D, Kromhout D. Dietary determinants of long-term incidence of chronic non-specific lung diseases: the Zutphen study. *Am J Epidemiol*. 1993;138:37-45.
5. Cook DG, Carey IM, Whincup PH. Effect of fresh fruit consumption on lung function and wheeze in children. *Thorax*. 1997;52:628-33.
6. Carey I, Strachan D, Cook D. Effects of changes in fresh fruit consumption on ventilatory function in healthy British adults. *Am J Respir Crit Care Med*. 1998;158:728-33.
7. Troisi RJ, Willett WC, Weiss ST, Trichopoulos D, Rosner B, Speizer FE. A prospective study of diet and adult-onset asthma. *Am J Respir Crit Care Med*. 1995;151:1401-8.
8. Ellwood P, Asher MI, Bjorksten B, Burr M, Pearce N, Robertson CF, et al. Diet and asthma, allergic rhinoconjunctivitis and atopic eczema symptom prevalence: an ecological analysis of the International Study of Asthma and Allergies in Childhood (ISAAC) data. *Eur Respir J*. 2001;17:436-43.
9. Hijazi N, Abalkhail B, Seaton A. Diet and childhood asthma in a society in transition: a study in urban and rural Saudi Arabia. *Thorax*. 2000;55:775-9.
10. La Vecchia C, Decarli A, Pagano R. Vegetable consumption and risk of chronic disease. *Epidemiology*. 1998;9:208-10.
11. Wood LG, Garg ML, Powell H, Gibson PG. Lycopene-rich treatments modify noneosinophilic airway inflammation in asthma: proof of concept. *Free Radical Research*. 2008;42:94-102.
12. Australian Government Department for Health and Aging. National Health and Medical Research Council. Australian dietary guidelines.2013.
13. US Department of Health and Human Services. US Department of Agriculture. Dietary guidelines for Americans 2005. [www.healthierusgov.gov/dietaryguidelines](http://www.healthierusgov.gov/dietaryguidelines) (accessed January 2011).
14. Australian Bureau of Statistics. Australian Health Survey: Updated Results2011-12.