

COPD and environmental risk factors other than smoking

2. Diet

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Date : 19th October 2007

1. Papers identified

Using the procedures described in “COPD and risk factors other than smoking. 1. Identifying Relevant Papers”, 51 papers were identified as relevant.¹⁻⁵¹

2. Specific studies

40 of these papers described results from particular studies, though the number of actual populations studies is less than this, as there are multiple publications from a number of studies, e.g. NHANES. Table 1 summarizes some relevant findings from these. It can be seen that most of the studies are of cross-sectional design, although there are some reports from prospective studies and studies of other design. Smoking is virtually always adjusted for in analyses, except in the experimental studies, where this is unnecessary due to the randomization. Most of the studies relate to levels of, or changes in, lung function, often FEV₁, though a few relate to diagnosed COPD. There are a large number of significant findings, with evidence of a beneficial effect for antioxidant vitamins, fruit, vegetables, fish and other dietary components generally considered to be part of a healthy diet. The only significant differences in the opposite direction relate to cured meat, a Western pattern diet and high blood glucose, though here evidence is clearly very limited.

3. Reviews

The remaining 10 papers^{8,10,17,26,28,32,36-38,46} are reviews that relate wholly or partly to diet. Some relevant sections from some of these are listed below:

Denny *et al* (2003)⁸

“The results of the studies identified in the review suggest that people who have a diet rich in fruit and vegetables have a lower risk of poor respiratory health, and that this may be due to the antioxidant nutrients these foods contain. On the basis of the evidence, it seems justified to promote a healthy diet, high in fruits, vegetables, and whole grain foods and low in alcohol and fatty foods, as set out in existing guidelines for prevention of cardiovascular disease and cancer, to protect respiratory health in both children and adults.”

Romieu and Trenga (2001)²⁶

“The results presented in this review suggest that the impact of nutrition on obstructive lung disease is most evident for antioxidant vitamins, particularly vitamin C and, to a lesser extent, vitamin E. By decreasing oxidant insults to the lung, antioxidants could modulate the development of chronic lung diseases and lung function decrement. Antioxidant vitamins could also play an important role in gene-environment interactions in complex lung diseases such as childhood asthma. Data also suggest that ω -3 fatty acids may have a potentially protective effect against airway hyperreactivity and lung function decrements; however, relevant data are still sparse. Although epidemiologic data suggest that consumption of fresh fruit may reduce risk of noncarcinogenic airway limitation, there are no clear data on which nutrients might be most relevant. While some studies evaluate daily intake of vitamin C, other studies use fruit consumption as a surrogate for antioxidant intake. Given the dietary intercorrelations among antioxidant vitamins, particularly vitamin C, β -carotene, and flavonoids, as well as other micronutrients, it may be difficult to isolate a specific effect. Some population subgroups with higher levels of oxidative stress, such as cigarette smokers, may be more likely to

benefit from dietary supplementation, since some studies have suggested that antioxidant intake may have a greater impact in this group.

Studies of lung function decrement and COPD in adults suggest that daily intake of vitamin C at levels slightly exceeding the current Recommended Dietary Allowance (60 mg/day among nonsmokers and 100 mg/day among smokers) may have a protective effect. In the Schwartz and Weiss and Britton et al. studies, an increase of 40 mg/day in vitamin C intake led to an approximate 20-ml increase in FEV₁. Daily mean vitamin C intakes in these studies were 66 mg and 99.2 mg, respectively, and the highest intake level (178 mg/day) was approximately three times the Recommended Dietary Allowance. Although the amplitude of the effect was modest, if these effects accumulate over 20-30 years, they could have a meaningful impact on the rate at which pulmonary function declines, particularly in symptomatic subjects. Longitudinal data support the hypothesis that fresh fruit consumption has a beneficial impact on the lung. Among children, consumption of fresh fruit, particularly fruit high in vitamin C, has been related to a lower prevalence of asthma symptoms and higher lung function. This effect was observed even at low levels of fruit consumption (one or two servings per week vs. less than one serving per week), which suggests that a small increase in dietary intake could have a beneficial effect. Consumption of fish has also been related to lower airway hyperreactivity among children and higher lung function in adults; however, longitudinal data do not provide evidence that increased ω -3 fatty acid intake protects against lung disease.”

Schünemann *et al* (2001)²⁸

“Several of the epidemiologic studies examining associations between antioxidant vitamin status and indicators of airway obstruction and pulmonary function have found these to indicate protective effects. However, the results are somewhat inconsistent for vitamin E, vitamin A, and carotenoids. The largest body of literature exists for vitamin C and fresh fruit and vegetable intake in relation to various indicators of airway obstruction.

The existing studies cannot distinguish an effect related to specific nutrients from that of a generally healthy diet with a combined effect of several nutritional factors. There are several other compounds with known antioxidant properties that are found in fruits and vegetables. Limited evidence exists that selenium intake may have protective effects in asthma. Flavanoids have strong antioxidant activity and protective effects in cardiovascular disease, but their role in respiratory disease remains to be explored.”

Smit *et al* (1999)³⁶

“In conclusion, the epidemiological evidence for a beneficial effect on indicators of asthma and COPD of eating fish, fruit and vegetables is increasing. However, the effectiveness of dietary supplementation in open-population samples is often not demonstrated. Several unresolved questions are raised, which should be addressed in future studies on the relationship between diet and respiratory disease.”

Smit *et al* (2001)³⁷

“Evidence for a role of diet in asthma and chronic obstructive pulmonary disease (COPD) has been accumulating rapidly over the past decade. Associations have been reported between the intake of fruit, fish, antioxidant vitamins, fatty acids, sodium or magnesium, and indicators of asthma and COPD. Several issues need to be addressed before causality of these associations can be established. The role of diet in the development of disease and the induction time and reversibility of the effect needs further investigation. The role of smoking habits in the relation of diet and respiratory disease also needs to be elucidated. Nevertheless, based on the available evidence, dietary guidelines could be proposed for the primary and secondary prevention of asthma and COPD that are in line with existing dietary guidelines for the prevention of coronary heart disease and cancer.”

4. Conclusion

It seems clear enough that diet is relevant to the risk of COPD, but as with diet and other health endpoints, such as cancer, there is always doubt as to precisely which the relevant dietary compounds are, and a lack of good evidence from randomized controlled intervention studies.

(Note that this review does not consider the evidence that shows that in COPD patients, malnutrition is prognostic of poor survival.)

5. References

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TABLE 1 Brief summary of results from 41 published papers relating to diet and COPD

<u>Source</u>	<u>Study Design^a</u>	<u>Dietary factor^b</u>	<u>Endpoint^c</u>	<u>Significant relationships^{b,d}</u>	<u>Smoking adjusted</u>
Balmes et al (1988) ¹	E	β -c and retinol	Lung function	No effect	No
Britton et al (1994) ²	C	Mg	FEV ₁	+	Yes
Britton et al (1995) ³	C	Vit C, vit E	Lung function	+	Yes
Butland et al (2000) ⁴	C	Vit C, vit E, β -c, fruits, fruit juices	FEV ₁	+ (apples, vit E)	Yes
Carey et al (1998) ⁵	P	Fruit	FEV ₁ change	+	Yes
Chuwers et al (1997) ⁶	C	β -c, retinol	Lung function	+	Yes
Cook et al (1997) ⁷	C	Fruit, veg, salads	FEV ₁	+ (fruit)	Yes
Dow et al (1996) ⁹	C	Vit C, vit E	Lung function	+ (vit E)	Yes
Grievink et al (1998) ¹¹	C	Vit C, vit E, β -c	Lung function	+ (vit C, β -c)	Yes
Grievink et al (1999) ¹²	C	Vit E, β -c	Lung function	Not significant	Yes
Grievink et al (2000) ¹³	C	Vit E, carotenoids	Lung function	+ (α -c, β -c, lycopene)	Yes
Hu et al (1998) ¹⁴	C	Vit C	FEV ₁	+	Yes
Hu and Cassano (2000) ¹⁵	C	Vit C, vit E, β -c, Se	Lung function	+ (all)	Yes
Jiang et al (2007) ¹⁶	C	Cured meat	Lung function	-	Yes
LaVecchia et al (1988) ¹⁸	C	Veg	CB	+	Yes
McKeever et al (2002) ¹⁹	P	Vit A, vit C, vit E, Mg	FEV ₁ change	+ (vit C)	Yes
Metzner et al (1983) ²⁰	C	Eats breakfast, no evening snack	CB	No relationship	No
Miedema et al (1993) ²¹	P	Total fruits, solid fruits	CNSLD	+	Yes
Morabia et al (1989) ²²	C	Various	AO ^e	+ (meat and poultry, milk, vit A index)	Yes
Morabia et al (1990) ²³	C	Retinol, carotenoids, vit E	AO ^e	+ (retinol)	Yes
Ness et al (1996) ²⁴	C	Vit C	Lung function	+	Yes
Rautal et al (1997) ²⁵	E	Vit E and β -c	CB	No relationship	No
Sargeant et al (2000) ²⁷	C	Vit E	AO	+	Yes
Schwartz and Weiss (1990) ²⁹	C	Various	CB	+ (vit C, Zn/Cu, K/Na)	Yes
Schwartz and Weiss (1994) ³⁰	C	Vit C	FEV ₁	+	Yes
Schwartz and Weiss (1994) ³¹	C	Fish	FEV ₁	+	Yes
Shahar et al (1994) ³³	C	n-3 PUFA	COPD	+	Yes

TABLE 1 Brief summary of results from 41 published papers relating to diet and COPD (cont/d)

<u>Source</u>	<u>Study Design</u> ^a	<u>Dietary factor</u> ^b	<u>Endpoint</u> ^c	<u>Significant Relationships</u> ^{b,d}	<u>Smoking adjusted</u>
Shahar et al (1994) ³⁴	C	Vit A	Lung function	No clear relationship	Yes
Sharp et al (1994) ³⁵	C	Fish	FEV ₁	+	Yes
Strachan et al (1991) ³⁹	C	Winter fresh fruit	FEV ₁	+	Yes
Ström et al (1996) ⁴⁰	C	Fat, vit A, vit C, Fe, Zn	AL ^s	No relationship	Yes
Tabak et al (1998) ⁴¹	Ec	Fruit, fish	COPD	+	Yes
Tabak et al (1999) ⁴²	C	Fruit, veg, vit C, vit E, β-c, fish	FEV ₁	+ (all except fish)	Yes
Tabak et al (2001) ⁴³	C	Catechins, flavanols, flavones	FEV ₁	+	Yes
Tabak et al (2001) ⁴⁴	C	Fruit, veg, fish, whole grain	FEV ₁	+ (fruit, whole grain)	Yes
Tockman et al (1986) ⁴⁵	C	Milk	CB	+	Yes
Varras et al (2007) ⁴⁷	P	Prudent diet (fruit, veg, fish, whole grain), Western pattern (refined grain, cured and red meats, desserts, French fries)	COPD	+ for prudent diet - for Western pattern	Yes
Walda et al (2002) ⁴⁸	C	Fruit, veg, fish, vit C, vit E, β-c	COPD	+ (fruit, vit E)	Yes
Walter et al (2003) ⁴⁹	C	Diabetes, fasting blood glucose	Lung function	-	Yes
Watson et al (2002) ⁵⁰	CC	Fruit, veg, dairy, starch	COPD	+ (fruit, veg)	Yes
Zoia et al (1995) ⁵¹	C	Dietary Na and K	Lung function	No association	Yes

^a Abbreviations used for study design:

C = cross-sectional
 Ec = ecological
 CC = case-control
 P = prospective
 E = experimental

^b Abbreviations used for dietary factors:

β-c = β-carotene
 PUFA = Polyunsaturated fatty acids
 Cu = Copper
 Se = Selenium
 Fe = Iron
 Vit = Vitamin
 K = Potassium
 Veg = Vegetables
 Mg = Magnesium
 Zn = Zinc
 Na = Sodium

^c Where lung function is given, various measures were studied

Abbreviations used for endpoints:

AO = Airway obstruction
 COPD = Chronic obstructive pulmonary disease
 AL = Airflow limitation
 FEV₁ = Forced expiratory flow in one minute
 CB = Chronic bronchitis
 FVC = Forced vital capacity
 CNSLD = Chronic non-specific lung disease

^d + Implies significant increase in lung function or decreased risk of disease associated with high intake levels of the dietary component,
 - Implies significant decrease in lung function or increased risk of disease associated with high intake levels of the dietary component

- e Defined as $FEV_1/FVC \leq 65\%$
- f Defined as $FEV_1 < 80\%$ and $FEV_1/FVC < 70\%$
- g Defined as $FEV_1/FVC < 70\%$