PAEDIATRICS

Nutrition and respiratory health in children in six Central and Eastern European countries

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Background: The results of studies on the effect of nutrition on respiratory diseases are inconsistent. The role of nutrition in children's respiratory health was therefore analysed within the cross sectional Central European Study on Air Pollution and Respiratory Health (CESAR).

Method: A total of 20 271 children aged 7–11 were surveyed in six European countries. Respiratory health and food intake were assessed using questionnaires. Associations between four symptoms and nutritional factors were evaluated using logistic regression, controlling for area plus other potential confounders.

Results: All symptoms showed initial associations with nutritional factors. Low consumption of fish and of summer and winter fruit were the most consistent predictors. In a fully adjusted model low fish intake remained a significant independent predictor of persistent cough (OR=1.18; 95% CI 1.04 to 1.34), wheeze ever (OR=1.14; 95% CI 1.03 to 1.25) and current wheeze (OR=1.21; 95% CI 1.06 to 1.39) and a weaker predictor of winter cough (OR=1.10; 95% CI 0.99 to 1.23). Low summer fruit intake was a predictor of winter cough (OR=1.40; 95% CI 1.10 to 1.79) and persistent cough (OR=1.35; 95% CI 1.01 to 1.82). Low winter fruit intake was associated with winter cough (OR=1.28; 95% CI 1.09 to 1.51). Associations between symptoms and vegetable intake were inconsistent. Low summer intake was significantly associated with winter cough (OR=1.23; 95% CI 1.03 to 1.47) but, overall, winter intake had inverse associations with both coughs. Associations between winter vegetable intake and wheeze varied considerably between countries.

Conclusion: A number of associations were found between respiratory symptoms and low intake of fish, fruit and vegetables in children. Low fish intake was the most consistent predictor of poor respiratory health. Fruit and vegetable intake showed stronger associations with cough than with wheeze.

An increase in the prevalence of respiratory diseases during the last decades has pointed scientific research towards identification of risk factors contributing to this negative trend in public health.[1] The wide variations in the prevalence of respiratory diseases and asthma in different countries are probably due to environmental and not genetic factors. It has been suggested that diets poor in antioxidants and minerals or with an unbalanced intake of essential fatty acids are among these potential risk factors for asthma and respiratory illness.[2 3]

The possible protective effects of fish intake on health may be due mainly to fish oil containing omega-3 polyunsaturated fatty acids (eicosapentaenoic acid (EPA) and decosahexaenoic acid (DHA)) which shunt the eicosanoid production away from the arachidonic acid pathway. Fish oil may therefore alleviate certain inflammatory respiratory diseases,[4 5] preserve normal airway resistance,[6] and modulate allergic sensitisation.[7] Fruit and vegetables are rich sources of a variety of nutrients including vitamins, trace minerals, dietary fibre and biologically active compounds which have antioxidant, antibacterial, and antiviral effects and assist in detoxification of enzymes and stimulation of the immune system.[8]

However, epidemiological evidence linking these foods to respiratory disease has not been consistent. A few studies have observed the beneficial effect of fruit[9 10] and vegetables[11] in relation to children's respiratory health, reporting a reduction in respiratory symptoms and respiratory infections and an improvement in pulmonary function. Several publications have supported these findings in adults,[12–17] but others[18 19] have shown no clear associations. A potential protective role of fish in reducing the risk of asthma in childhood was reported in Australia.[20] A crude association found between fish intake and asthma among Saudi Arabian children did not prove robust to controlling for other risk factors, and an increased risk of asthma with fish consumption has been reported in Japanese children.[21 22]

In this paper we present data relating diet to respiratory symptoms among children participating in the Central European Study on Air pollution and Respiratory health (CESAR). Although the main focus of the CESAR study was on the relation between air pollution and children's respiratory health, some information was also gathered on diet. The resulting data set from over 20 000 children allowed us to examine the role played by nutritional factors, testing the hypotheses that low intake of fresh fruit, vegetables, and fish increases the risk of respiratory disorders.

METHODS

A cross sectional multicentre study was performed in 1996 in a total of 25 areas in six Central and Eastern European countries (Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia). Within each country, towns were selected to create a contrast in exposure to particulate air pollution. Other selection criteria were: an homogenous exposure of the subjects within each town, a sufficient number of primary school children (>1500), relatively low migration rate, and comparable socioeconomic profile (towns of about 100 000 citizens with comparable lifestyle characteristics, organised and accessible health services, and accessible education). A detailed selection procedure of the study areas has been described by Houthuijs *et al.*[23]

In each area about 1000 primary school children aged 7–11 were invited to participate in the study. The children were

Table 1 Prevalence (%) of selected respiratory symptoms and frequency (%) of fish, fruit and vegetable intake in children from six Central and Eastern European countries

| Food intake | Prevalence (%) of studied respiratory symptoms (total for all six countries) | | | | Frequency (%) of fish, fruit and vegetable intake | | | | | | |
	Winter cough	Persistent cough	Wheeze ever	Current wheeze	All countries	Bulgaria	Czech Republic	Hungary	Poland	Romania	Slovakia
Fish intake	n=19726	n=19790	n=19218	n=19463	n=20001	n=3591	n=3460	n=3673	n=2922	n=3332	n=3023
≥1/month	22.1	13.1	24.3	9.3	77.3	74.8	87.3	63.5	92.6	60.8	89.3
<1/month	20.3	13.2	27.9	10.2	22.7	25.2	12.7	36.5	7.4	39.2	10.7
Fresh fruit in summer	n=19718	n=19785	n=19216	n=19460	n=19992	n=3565	n=3449	n=3685	n=2914	n=3366	n=3013
>4/week	20.9	13.0	24.4	9.4	74.6	68.4	83.2	72.0	77.5	64.9	83.1
2–4/week	22.9	12.8	26.6	9.5	21.8	24.9	15.6	24.8	20.3	28.4	15.5
<2/week	30.8	15.7	31.1	11.4	3.7	6.8	1.2	3.2	2.2	6.7	1.3
Fresh fruit in winter	n=19718	n=19782	n=19213	n=19457	n=19987	n=3571	n=3448	n=3680	n=2919	n=3354	n=3015
>4/week	21.7	14.3	23.4	9.5	42.2	29.2	62.3	30.0	43.2	28.2	64.5
2–4/week	20.5	12.0	24.8	9.1	43.1	42.7	34.0	54.8	47.6	46.6	31.5
<2/week	25.0	12.4	31.0	10.4	14.7	28.1	3.8	15.2	9.3	25.2	4.0
Fresh vegetables in summer	n=19754	n=19825	n=19253	n=19496	n=20028	n=3576	n=3454	n=3681	n=2921	n=3376	n=3020
>4/week	21.9	13.5	26.4	10.2	58.1	83.8	55.6	29.4	61.6	70.9	48.1
2–4/week	20.9	12.2	22.8	8.3	34.3	13.1	38.7	56.9	31.8	22.5	42.5
<2/week	23.6	13.2	24.9	9.0	7.6	3.1	5.8	13.8	6.6	6.7	9.4
Fresh vegetables in winter	n=19710	n=19775	n=19205	n=19450	n=19976	n=3555	n=3445	n=3681	n=2921	n=3354	n=3020
>4/week	26.2	16.2	23.9	11.1	13.0	9.3	17.3	7.5	20.3	12.8	12.4
2–4/week	21.0	12.8	22.8	8.7	45.0	22.3	54.5	59.3	51.7	34.5	48.6
<2/week	21.1	12.3	27.9	9.7	42.0	68.4	28.2	33.2	28.0	52.7	39.0

Table 2 Adjusted odds ratio (OR) and 95% confidence interval (CI) of children's respiratory health associated with frequency of fish intake

| Outcome variables of respiratory health | Risk factors variables (categories) | Model 1 | | | Model 3 | | |
		OR*	95% CI	p value	OR†	95% CI	p value
Winter cough			n=19725			n=16853	
	≥1/month	1 (ref)			1 (ref)		
	<1/month	1.31	1.20 to 1.44	<0.001	1.10	0.99 to 1.23	0.07
Persistent cough			n=19789			n=16895	
	≥1/month	1 (ref)			1 (ref)		
	<1/month	1.30	1.16 to 1.45	<0.001	1.18	1.04 to 1.34	0.01
Wheeze ever			n=19217			n=16471	
	≥1/month	1 (ref)			1 (ref)		
	<1/month	1.19	1.09 to 1.29	<0.001	1.14	1.03 to 1.25	0.01
Current wheeze			n=19462			n=16648	
	≥1/month	1 (ref)			1 (ref)		
	<1/month	1.24	1.10 to 1.40	<0.001	1.21	1.06 to 1.39	0.01

*OR adjusted for area, age, and sex.
†OR adjusted for all tested nutritional factors included simultaneously in the model and for area, age, sex, pets, indoor moisture, use of gas oven for heating, additional unvented gas heating, passive smoking, mother's education, father's occupation, parent's allergy, respondent and overcrowding.
p=p for trend.

recruited through their schools. Written consent was obtained from the parents of the children in January–February 1996 except in Bulgaria where consent was obtained verbally. Data on their respiratory health were gathered by questionnaires filled out by the parents of the children in February–May 1996.[24]

The questionnaire was composed of sections on the child's respiratory health and on lifestyle risk factors including socio-economic status, passive smoking, indoor factors, nutrition, etc. The questions were created following the World Health Organisation questionnaire on chronic airflow limitation in children[25] and the ISAAC questionnaire on asthma in children.[26]

Definition of outcome respiratory variables

Four outcome variables for children's health—two for cough, two for wheeze symptoms—were defined as follows:

Winter cough: "yes" to question "Does this child usually cough during the day or at night in autumn-winter season?"

Persistent cough: "yes" to question "Did this child cough on most days for at least 3 months consecutively in the last autumn-winter season?"

Wheeze ever: "yes" to one or both of the following questions "Has this child ever had wheezing or whistling in the chest at any time in the past" and "Has this child ever had attacks of shortness of breath with wheezing?".

Current wheeze: "yes" to question "Has the child's chest sounded wheezy or whistling in the last 12 months?".

Definition of nutritional risk factors

Based on previous studies[27 28] which showed that food frequency measures are accurate and useful in screening dietary surveillance, we redesigned the part of the food frequency questionnaire used in the British survey of adults[15] for our study. The questions were orientated to determine the intake of fish, fruit (in summer and in winter separately), and vegetables (also in summer and winter). Parents were asked to report on the frequency of seasonal consumption of fresh food

Table 3 Adjusted odds ratio (OR) and 95% confidence interval (CI) of children's respiratory health associated with frequency of fruit intake

Outcome variables of respiratory health	Risk factor variables (categories)	Fruit intake in summer						Fruit intake in winter					
		Model 1			Model 3			Model 1			Model 3		
		OR*	95% CI	p value	OR†	95% CI	p value	OR*	95% CI	p value	OR†	95% CI	p value
Winter cough	>4/week	1 (ref)	n=19717		1 (ref)	n=16853		1 (ref)	n=19717		1 (ref)	n=16853	
	2–4/week	1.25	1.15 to 1.37		1.06	0.95 to 1.20		1.10	1.01 to 1.19		1.00	0.90 to 1.11	
	<2/week	2.13	1.78 to 2.54	<0.001	1.40	1.10 to 1.79	0.02	1.74	1.55 to 1.95	<0.001	1.28	1.09 to 1.51	0.03
Persistent cough	>4/week	1 (ref)	n=19784		1 (ref)	n=16895		1 (ref)	n=19781		1 (ref)	n=16895	
	2–4/week	1.11	1.00 to 1.24		1.03	0.90 to 1.19		1.06	0.96 to 1.16		1.00	0.88 to 1.13	
	<2/week	1.54	1.24 to 1.91	<0.001	1.35	1.01 to 1.82	0.14	1.28	1.11 to 1.47	0.002	0.97	0.79 to 1.20	0.85
Wheeze ever	>4/week	1 (ref)	n=19215		1 (ref)	n=16471		1 (ref)	n=19212		1 (ref)	n=16471	
	2–4/week	1.08	1.00 to 1.17		1.04	0.93 to 1.15		1.01	0.94 to 1.09		0.95	0.87 to 1.05	
	<2/week	1.20	1.01 to 1.42	0.01	0.96	0.77 to 1.21	0.79	1.19	1.07 to 1.32	0.01	1.01	0.87 to 1.17	0.83
Current wheeze	>4/week	1 (ref)	n=19459		1 (ref)	n=16648		1 (ref)	n=19456		1 (ref)	n=16648	
	2–4/week	1.04	0.93 to 1.18		1.10	0.95 to 1.29		0.99	0.89 to 1.11		0.92	0.80 to 1.05	
	<2/week	1.26	0.98 to 1.61	0.10	1.25	0.91 to 1.73	0.10	1.12	0.96 to 1.31	0.27	0.89	0.71 to 1.10	0.21

*OR adjusted for area, age and sex. †OR adjusted for all tested nutritional factors included simultaneously in the model and for area, age, sex, pets, indoor moisture, use of gas oven for heating, additional unvented gas heating, passive smoking, mother's education, father's occupation, parent's allergy, respondent and overcrowding. p=p for trend.

according to the usual routine in their family. For each dietary factor there were four possible responses: >4 times per week, 2–4 times per week, 1–4 times per month, and never or less than once per month. To avoid baseline groups of <10% and other small categories we aggregated the groups as follows. For fruit and vegetable variables: more than 4 times per week (baseline), 2–4 times per week, and less than twice per week. For fish intake: more than once per month (baseline) and less than once per month.

Statistical analysis

The prevalence of respiratory symptoms, odds ratios (ORs) and 95% confidence intervals (CI) were determined using Stata version 6 (StataCorp, TX, USA) The ORs were estimated by logistic regression, controlling for potential confounders chosen a priori. All confounders were from the questionnaire and were included in the model as categorical variables. Tests for trend across categories of a variable were performed by including it as a linear term rather than a categorical one. This was done separately for each variable of interest—that is, while other terms were left in their categorical form.

Three statistical models were used. The first model included age, sex and area as potential confounding factors. The second model contained, in addition, the following variables: presence of pets, presence of indoor moisture, use of gas oven for heating, additional unvented gas heating, number of smokers in household (0, 1, 2 or 2+), mother's education (higher, secondary, apprenticed, primary), father's occupation (professional, clerical, skilled manual, semi/unskilled, undefined), parent's allergy (0, 1, 2 parents with allergy), respondent (person that filled out the questionnaire), and overcrowding (>1 person per room). The third contained, in addition, all nutritional risk factors simultaneously in order to identify their independent associations with the outcomes.

The results from the second model were very similar to those from the fully adjusted third model, and for simplicity we report only the latter. This was true for all the nutritional factors.

The likelihood ratio test was used to test for interactions between country and nutritional factors. Where these interactions were significant the results are given separately for each country, obtained by including interaction terms in the final model.

RESULTS

A total of 33 051 children were invited to participate in the study. The parents of 23 731 (71.8%) gave consent for their participation; 21 743 questionnaires were returned, a response rate of 65.8%. A database was created from 20 271 (61.3%) children aged 7–11 years. Children who changed address in 1995 (the year before the study, n=1194) or who did not fulfil the age criteria (n=194) were not included in the database. Eighty four questionnaires were not entered for various reasons, in most cases because data from all items were missing.

Fish

The "high consumption" group contained the most children, both overall and for each country (table 1). Low fish consumption was consistently associated with respiratory health (table 2). After adjusting for age, sex and area, the estimated ORs for low versus high fish intake were 1.30 for both persistent cough and winter cough, 1.24 for current wheeze, and 1.19 for wheeze ever. In the third model which contained all nutritional factors simultaneously as well as additional potential confounders, independent associations were retained with persistent cough (OR=1.18; 95% CI 1.04 to 1.34), wheeze ever (OR=1.14; 95% CI 1.03 to 1.25) and current wheeze (OR=1.21; 95% CI 1.06 to 1.39), and a weaker association with winter cough (OR=1.10; 95% CI 0.99 to 1.23).

Table 4 Adjusted odds ratio (OR) and 95% confidence interval (CI) of children's respiratory health associated with frequency of vegetable intake

Outcome variables of respiratory health	Risk factor variables categories	Vegetable intake in summer						Vegetable intake in winter					
		Model 1			Model 3			Model 1			Model 3		
		OR*	95% CI	p value	OR†	95% CI	p value	OR*	95% CI	p value	OR†	95% CI	p value
Winter cough		n=19753			n=16853			n=19709			n=16853		
	>4/week	1 (ref)			1 (ref)			1 (ref)			1 (ref)		
	2–4/week	1.15	1.06 to 1.24		1.07	0.97 to 1.18		0.90	0.81 to 1.01		0.86	0.75 to 0.97	
	<2/week	1.49	1.30 to 1.72	<0.001	1.23	1.03 to 1.47	0.02	1.04	0.93 to 1.16	0.12	0.81	0.70 to 0.94	0.01
Persistent cough		n=19824			n=16895			n=19774			n=16895		
	>4/week	1 (ref)			1 (ref)			1 (ref)			1 (ref)		
	2–4/week	1.00	0.90 to 1.10		0.98	0.87 to 1.10		0.85	0.75 to 0.97		0.80	0.69 to 0.93	
	<2/week	1.23	1.04 to 1.46	0.10	1.10	0.88 to 1.36	0.70	0.91	0.80 to 1.04	0.48	0.79	0.67 to 0.94	0.03
Wheeze ever		n=19252			n=16471			n=19204			n=16471		
	>4/week	1 (ref)			1 (ref)			1 (ref)			1 (ref)		
	2–4/week	1.02	0.95 to 1.11		0.97	0.88 to 1.06		1.00	0.90 to 1.11		1.00	0.88 to 1.13	
	<2/week	1.17	1.02 to 1.33	0.05	1.07	0.90 to 1.26	0.87	1.09	0.98 to 1.22	0.03	1.03	0.89 to 1.18	0.58
Current wheeze		n=19495			n=16648			n=19449			n=16648		
	>4/week	1 (ref)			1 (ref)			1 (ref)			1 (ref)		
	2–4/week	0.93	0.83 to 1.04		0.90	0.79 to 1.03		0.83	0.71 to 0.96		0.87	0.73 to 1.04	
	<2/week	1.08	0.89 to 1.31	0.87	1.05	0.82 to 1.34	0.60	0.87	0.74 to 1.01	0.20	0.85	0.70 to 1.03	0.16

*OR adjusted for area, age and sex. †OR adjusted for all tested nutritional factors included simultaneously in the model and for area, age, sex, pets, indoor moisture, use of gas oven for heating, additional unvented gas heating, passive smoking, mother's education, father's occupation, parent's allergy, respondent and overcrowding. p=p for trend.

Fruit

For both summer and winter intake, the "high consumption" group contained the most children overall and the "low consumption" group contained the fewest (table 1), although for individual countries there was some variation regarding winter consumption. Winter cough was consistently associated with both summer and winter intake, with ORs for the lowest versus the highest intake groups in the final model of 1.40 (95% CI 1.10 to 1.79) and 1.28 (95% CI 1.09 to 1.51), respectively, and with significant trends across the intake categories (table 3). Associations with persistent cough and wheeze ever were less consistent, with trends being non-significant in the final model, although there remained a difference in persistent cough between the highest and lowest intake groups of summer fruit. No significant associations were seen between fruit intake and current wheeze.

Vegetables

For summer intake the "high consumption" group again contained the most children overall and the "low consumption" group contained the fewest (table 1), but the intake of winter vegetables was considerably lower. Over 40% of the children overall ate less than two portions of fresh vegetables per week in winter, ranging from 28% in Poland to 68% in Bulgaria.

Summer vegetable intake showed a consistent association with winter cough, with an OR for the lowest versus highest intake groups in the final model of 1.23 (95% CI 1.03 to 1.47) and a significant trend across categories (table 4). Other associations with summer intake were less consistent, as were those with winter intake. After adjustment for potential confounders, low consumption of winter vegetables had an inverse association with both persistent cough and winter cough, and little association with wheeze symptoms. However, likelihood ratio tests showed highly significant interactions between country and winter vegetables for both wheeze outcomes (p<0.001). Country specific associations ranged from an inverse trend for current wheeze in the Czech Republic with an OR of 0.58 (95% CI 0.41 to 0.81) for the lowest versus highest intake group, to an OR for current wheeze of 2.29 (95% CI 1.40 to 3.74) and for wheeze ever of 1.96 (95% CI 1.44 to 2.67) in Bulgaria, with the remainder of the associations being non-significant or only weakly significant.

Low fish intake was therefore the most consistent predictor of poor respiratory health, having significant independent associations with both cough and wheeze symptoms. Fruit intake was associated with cough symptoms, particularly winter cough, but not with wheeze symptoms. The associations with vegetable intake were inconsistent, with a higher summer intake giving a protective effect for winter cough, while a higher winter intake of vegetables was associated with increased winter cough. Associations between wheeze symptoms and winter vegetable intake were inconsistent between countries.

DISCUSSION

This is the first attempt to analyse the role of potential nutritional risk factors in the respiratory health of children from Central and Eastern European countries. The most important finding is a clear independent association between fish intake and children's respiratory illness, particularly symptoms of wheeze and persistent cough. Hodge et al[20] found that fish intake had a protective effect against childhood asthma in Australia, but otherwise there has been little consistent evidence of these associations.

Our high fish consumption category (>1 portion per month) is not particularly high, but the categories were formed in this way to avoid groups with very small numbers. To check that our finding was not an artefact of grouping we performed a sensitivity analysis using a three level fish variable: >2 portions/week (baseline group), 1–4 times/

month, and never or <1/month. Significance was greatly reduced as expected, but similar patterns of association were seen with ORs for the lowest versus highest group of 1.23 (95% CI 1.01 to 1.51, p trend=0.013) for persistent cough, 1.08 (95% CI 0.92 to 1.27, p trend=0.058) for wheeze ever, 1.13 (95% CI 0.90 to 1.42, p trend=0.049) for current wheeze, and 1.05 (95% CI 0.90 to 1.24, p trend=0.3) for winter cough (results not shown).

In accordance with some previous studies,[9][10] our results broadly support the hypothesis of beneficial effects of fruit consumption on respiratory health, although on cough rather than wheeze symptoms. Without wishing to place too much emphasis on the least consistent results, we consider why (a) fruit consumption has stronger associations than vegetable consumption and (b) winter consumption has weaker associations—sometimes in the opposite direction—than summer consumption.

It may be that the protective effects of high fruit intake on respiratory health are genuinely much stronger than for vegetable intake. A clear beneficial association between vegetable consumption and chronic bronchitis and bronchial asthma in adults has been reported only by La Vecchia et al[17] and a weaker beneficial trend was reported by Butland et al.[13] A recent report has linked tomato intake with a reduction in respiratory infections in Sudanese children.[11]

The associations of higher symptom prevalence with greater winter vegetable consumption may also reflect true relationships, although we doubt this. They may be chance findings or a result of uncontrolled confounding, but we have used a wide range of individual potential confounders in our model. Another possible explanation may be that of reverse causality, given that consumption of winter vegetables was very low. In winter, when symptoms of bronchitis are most likely to be present, if fresh vegetables are given preferentially to (or sought out for) sick children, this could produce the observed results. We note that, conversely, for fruit (which is far less scarce), although associations with health are weakened they do not become inverse. Further research is needed to obtain detailed nutritional data and to explore and clarify the inconsistent associations between winter vegetable consumption and respiratory health seen across this region. Smit[29] noted the inconsistency between results of previous (mainly adult) studies and recommended a meta-analysis, and this or a pooled analysis may form another approach to clarify real associations.

One of the limitations of our study is that the analysis relied on questionnaire data for frequency of food intake, but it was not possible to estimate the precise amounts and types of food, their nutrients, minerals, or total energy intake. Our exposure variables were therefore to some extent "blunt instruments", and prevented us from further distinguishing between oily and white fish, for example, or between different types of vegetables. If the "bluntness" of the nutritional variables caused misclassification we would expect this to be random, therefore biasing results towards the null. We have made great efforts to remove confounding, but inevitably some may remain. Similarly, care was taken to minimise language discrepancies in the questionnaire. A further limitation is that participants knew that the study focused on respiratory health. A wide range of potential risk factors were covered; we think serious selection or recall biases related to an association between nutrition and health are unlikely but cannot rule them out. We estimate a "real" response rate of over 65%, given that some of the invited participants were ineligible for the study. Other studies quoted here had response rates ranging from 39% to 92%.

In summary, the results of our study support the hypothesis of a link between diet and respiratory health. However, estimates of effect are moderate with positive ORs ranging from about 1.10 to 1.40. The proportion of subjects with current wheeze attributable to eating fish less than once a month,

for example, is 3.7% (95% CI 1.0 to 6.3), but these figures refer to common childhood symptoms with a prevalence of about 10% for current wheeze and over 20% for winter coughs. Respiratory illnesses may impact on children's schooling, affect their future health, and increase the burden both on families and on health services. Asthma in particular has been increasing in prevalence, with hypothesised links to traffic pollution and to lifestyle (which may include diet). In such a context, appropriate nutrition may have an important role to play in maintaining health and reducing the prevalence of these symptoms and their resulting burden.

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LUNG ALERT ....

Pulmonary artery catheters are not routinely indicated during and after surgery

▲ Sandham JD, Hull RD, Brant RF, *et al* for the Canadian Critical Care Clinical Trials Group. A randomized, controlled trial of the use of pulmonary-artery catheters in high-risk surgical patients. *N Engl J Med* 2003;**348**:5–14

Recent observational studies suggest that the use of pulmonary artery catheters to guide treatment is associated with increased mortality. Outcomes have been confounded by the severity of the underlying illness. This multicentre, randomised, controlled clinical trial involving blinded assessment of outcomes compared treatment guided by a pulmonary artery catheter with standard treatment (not guided by a pulmonary artery catheter) in 1994 at risk elderly patients (American Society of Anaesthesiologists class III and IV risk) undergoing surgery followed by a stay in the intensive care unit (ICU). Patients were aged ≥60 years and were scheduled for urgent or elective major abdominal, thoracic, vascular, or hip fracture surgery. There was no difference between the two groups in rate of in-hospital mortality, length of hospital stay (median 10.0 days for both), or survival at 6 or 12 months. However, there was a higher rate of acute pulmonary embolism in the catheter group (8 *v* 0, p=0.004).

The study showed that, in this group of patients, medical management directed by pulmonary artery catheters had no advantage over standard treatment. Whether the results of this study extend to patients other than those at high risk is not at present known.

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