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Early respiratory experience and subsequent cough and peak expiratory flow rate in 36 year old men and women

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Abstract

Earlier work on the respiratory health of members of the Medical Research Council's national survey of health and development (1946 birth cohort) was extended to age 36. At that age measures of peak expiratory flow rate and respiratory symptoms, elicited by the MRC chronic bronchitis questionnaire, were made in 3261 cohort members. In both men and women lower peak expiratory flow and higher respiratory morbidity were independently associated not only with current indices of poor social circumstances and cigarette smoking but also with poor home environment at age 2 years and lower respiratory tract illness before age 10.

The findings provide additional evidence for a causal relation between childhood respiratory experience and adult respiratory disease.

Introduction

The idea that there may be childhood origins of adult chest disease has intrigued researchers for over 20 years. Reid and Fairbairn in 1958 noted that postmen with chronic bronchitis often had a history of respiratory illness going back to early adult life,[1] and Oswald *et al* in 1953 found among chronic bronchitics in hospital an excess with a history of childhood chest illnesses.[2] These and other studies raised the question whether adverse respiratory experience in childhood might lead to adult chronic bronchitis.[3,4] Much of the evidence was reviewed by Samet *et al*.[5] A recent study of infant mortality from respiratory illness in England and Wales in 1921-5 and adult mortality from bronchitis in 1959-78 provides further evidence of a link between childhood and adult respiratory disease.[6]

Interest has also focused on those factors that may influence the risk of respiratory illness in children. One such study, by Douglas and Waller, explored the role of social and environmental factors, including air pollution, in such illness.[7] Douglas and Waller showed in their follow up of the cohort born in 1946 (Medical Research Council's national survey of health and development) that lower respiratory tract infections under the age of 2 years were related to air pollution and that the frequency and severity of infection increased with increasing air pollution. Also children of working class parents were twice as likely to have such infections as middle class children. In the same cohort at 20 years of age Colley *et al* showed that current cigarette smoking and serious respiratory illness before age 2 were associated with respiratory symptoms at age 20 but that social origin and air pollution were not.[8] When the cohort was contacted at age 25 Kiernan *et al* confirmed that current cigarette smoking and serious respiratory illness before age 2 were associated with respiratory symptoms but found that social origin, as measured by father's social class, had also begun to show an association with these symptoms.[9] In this context it may be noted that Reid had suggested that the social class gradients in mortality from chronic bronchitis seen in later life may partly reflect the residual influences of social class effects in childhood.[3] Exposure of cohort members to air pollution before age 11, though apparently having a stronger association with respiratory symptoms at 25 than 20, again did not achieve statistical significance. It thus seemed from these studies that childhood respiratory experiences might have long term influences on adult respiratory disease and possibly that these influences would become more apparent as the cohort aged. As follow up of the 1946 birth cohort has continued it has proved possible to explore these hypotheses at a later age. The most recent contact was made in 1982, when the cohort was 36. This paper reports findings at that age in relation to childhood and adult home circumstances and respiratory experience.

Subjects and methods

The MRC national survey of health and development is a longitudinal study of 5362 women and men who were born in the first week of March 1946 in England, Scotland, and Wales.[10] The original population was sampled to

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TABLE I—*Mean peak flow rates adjusted for height analysed by sex and respiratory symptoms*

		Men			Women		
		l/min	No	p Value	l/min	No	p Value
Winter morning cough	No	560·5	1389	<0·001	415·6	1468	<0·001
	Yes	518·9	231		379·6	169	
Cough day or night in winter (chronic cough)	No	558·1	1463	<0·001	415·1	1497	<0·001
	Yes	514·2	141		376·0	125	
(If "yes" to winter cough) Persistent cough	No	522·0	92	NS	388·8	81	NS
	Yes	513·7	140		372·7	105	
Winter morning phlegm	No	558·9	1400	<0·001	414·0	1512	<0·001
	Yes	525·5	205		386·7	119	
Phlegm day or night in winter	No	557·1	1487	<0·001	413·5	1545	<0·001
	Yes	522·6	112		383·8	74	
(If "yes" to phlegm) Persistent phlegm	No	525·9	105	NS	402·4	73	<0·01
	Yes	524·1	109		361·7	59	
Cough and phlegm for three weeks or more	No	556·5	1386	<0·05	412·8	1402	NS
	Yes	543·8	230		405·6	234	
Wheezy chest ever	No	564·1	1187	<0·001	417·3	1305	<0·001
	Yes	528·9	430		391·2	334	
(If "yes" to wheeze) Wheezy chest most days and nights	No	540·6	325	<0·001	401·6	261	<0·001
	Yes	492·2	89		349·5	60	
Chest illness in past three years	No	557·6	1500	<0·001	414·2	1469	<0·001
	Yes	515·4	118		392·5	164	
(If "yes" to chest illness) No of chest illnesses in past three years*	One	516·3	76	NS	405·6	93	<0·05
	Two	514·7	38		373·5	66	

*Missing information accounts for numbers being less than those who answered "yes" to previous question.

include all the children of non-manual workers and agricultural workers but only one in four children of manual workers. Contacts were made at least every two years with the mothers of the cohort members until 1961, when the children were 15. Contacts were subsequently made with the cohort members themselves. A wide range of data has been collected on medical, social, psychological, and education topics.

Data on the child's home environment including overcrowding in the child's home, the type of dwelling, ownership of the home, the child's sleeping arrangements, family size at age 2 years, occupation of the father, and respiratory infections before the age of 2 were collected by the health visitor who interviewed the mother at home when the child was 2. Interviews were repeated when the child was 4, 6, 8, and 11 years old.

In 1982, when the cohort was 36, specially trained nurses interviewed members at home, made certain clinical measurements, and collected detailed medical, social, and psychiatric information. Among such data were five peak expiratory flow rate measurements made with the subjects seated using mini Wright peak flow meters. Height was measured in centimetres to the nearest 0·5 cm below. Respiratory symptoms were sought using questions approved by the MRC committee on the aetiology of chronic bronchitis.[11] The questions were identical with those asked of the survey members in 1966, 1971, and 1977 at ages 20, 25, and 31 respectively. Current smokers, ex-smokers, and non-smokers were identified from information collected about smoking on the same four occasions between 1966 and 1982. Social information collected at age 36 included questions on home ownership.

At age 36, 3322 cohort members were interviewed. These represented 88·5% of those who were contacted in 1982. For each person a summary measure of lung function was obtained by taking the mean of the last three peak expiratory flow rate readings. To permit comparisons between the peak expiratory flow rate readings of individual members allowance for differences in body size was made by adjusting each person's mean reading to the average height for cohort members of the same sex. This summary measure was available for 3261 (98·2%) of the cohort members interviewed.

Factors associated with early respiratory illness were identified and their relations with peak expiratory flow rates adjusted for height and with cough day or night in winter (hereafter referred to as "chronic cough") examined. Those factors that were statistically significantly associated with peak expiratory flow rates or chronic cough were explored by analysis of variance[12] and logistic regression.[13]

Results

Peak expiratory flow rate and respiratory symptoms—The measurement of ventilatory capacity was used to validate the questions about respiratory morbidity. Table I shows the mean peak expiratory flow rates in men and women reporting the presence and absence of respiratory symptoms. There was a consistent trend for those with symptoms to have a lower peak expiratory flow rate than those who were symptom free, but the differences did not always reach statistical significance. Some of the factors on house and family circumstances collected in childhood were found to have an association with respiratory experience by age 2. These included overcrowding; sharing a bed with a parent or sibling; and having more than one sibling, a father who was a manual worker, and parents who were not owner occupiers. These factors together with cigarette smoking and home ownership at age 36 were analysed in relation to chronic cough and peak expiratory flow rate.

Respiratory symptoms—Table II shows the associations between selected factors from childhood and adult life and the prevalence of chronic cough at age 36. The main differences in prevalence rates were associated with contemporary factors—that is, current smoking habit and home ownership. Of the earlier childhood associations, the main difference occurred in respect of respiratory illness up to age 10. To assess the effect of each factor independently of all the others a logistic regression analysis was carried out (table III). Only four factors showed significant differences in prevalence. In order of magnitude these were smoking habit, home ownership at age 36, respiratory illness up to age 10, and crowding at age 2.

Peak expiratory flow rate—After adjustment for height the mean peak expiratory flow rate for men was greater than for women (554·4 l/min *v* 411·8 l/min). Table IV shows these values for men and women in relation to the same set of factors examined above. The lowest peak flow rates in each sex were observed for those who were council tenants. For women low peak flow was also seen in those who were in overcrowded conditions at age 2, shared a bed at age 6, and had respiratory illness before age 10. In men low peak flow was also seen in current smokers, those who were overcrowded or lived in large families at age 2, and those who had respiratory illness before age 10. There were no statistical interactions between sex and any of the other factors, so an analysis of variance was performed for both sexes together, keeping sex as a dummy variable (table V). This showed that peak expiratory flow rate was independently associated with the same set of factors as chronic cough.

Discussion

These findings are derived from a nationally representative sample of men and women who were born in England, Wales, or Scotland in March 1946 and were followed up to 36 years of age. Aspects of environmental, social, and respiratory experience were collected in childhood and in adult life. This information provides a unique opportunity to explore the relevance of these childhood

factors to disease later in life, without the biases that arise when adults try to recollect events in childhood. This was also the first occasion in the follow up of the cohort that ventilatory function was measured. Reassuringly, peak expiratory flow rates in subjects without respiratory symptoms were greater than in those with these symptoms, thus supporting the validity of answers given to the respiratory questionnaire.

Of the broad range of social and environmental factors collected at age 36, those most strongly and independently associated with a low peak expiratory flow rate and respiratory symptoms were cigarette smoking and being a council tenant. The association of respiratory symptoms with cigarette smoking was also found in the cohort at 20 and 25 years.[8,9] Other studies have found adult respiratory morbidity[14] and mortality[15] to be greater in council tenants than house owners, which has been taken to represent the effects of comparatively poor environmental circumstances. Interestingly, in both men and women ex-smokers had the highest peak expiratory flow rates.

Despite the strong relation with smoking habits and environment at 36 years the two indicators of respiratory health were also independently associated with childhood respiratory illness and home environment. Those who had lived in crowded circumstances at age 2 and those who had experienced lower respiratory tract illness before the age of 10 were at significantly greater risk of a low peak expiratory flow rate and higher rates of respiratory symptoms. The two studies of the cohort at 20 and 25 years had also shown strong and independent associations between childhood chest illness before the age of 2 and adult respiratory symptoms.[8,9] There can now be little doubt in this cohort of the existence of an association between childhood respiratory experience and adult respiratory morbidity. What cannot yet be determined is whether there is an association with adult chronic bronchitis; members of the cohort are not old enough for a significant number to have developed florid chronic respiratory disease. As it is intended to study the cohort at later ages, the opportunity will be taken to explore this aspect further.

Still to be resolved is whether the association between childhood and adult respiratory experience represents a causal or non-causal relation or some mixture of the two. Are we observing people who have a general, genetic susceptibility to respiratory disease, or people who in childhood suffered lung damage as a result of an early lower respiratory tract infection that predisposed them to an excess of respiratory troubles, and possibly chronic bronchitis, in adult life? So far there is no conclusive evidence with which to answer this question.[5] Nevertheless, the earlier findings in the cohort of strong

TABLE II—*Percentage prevalence of chronic cough at age 36 analysed by various factors*

	Prevalence (%)	No
Sex:		
Women	7·8	1647
Men	8·8	1635
Crowding at age 2:		
Up to one person per room	6·6	1723
Over one person per room	10·7	1382
Home ownership at age 2:		
Owner occupied	6·4	745
Other	8·8	2340
Family size at age 2:		
Up to two children	7·5	2053
Over two children	10·5	879
Father's social class at age 4:		
Non-manual	6·2	1254
Manual	10·1	1769
Sleeping arrangements at age 6:		
Slept alone	7·8	2097
Shared bed	10·0	916
Respiratory illness up to age 10:		
No illness	7·1	2254
Illness	11·7	828
Home ownership at age 36:		
Owner occupier	6·3	2449
Council tenant	15·8	469
Other	12·2	360
Cigarette smoking at age 36:		
Current smoker	16·3	1116
Ex-smoker	4·7	1195
Never smoked	3·6	969

TABLE III—*Percentage prevalence of chronic cough at age 36 adjusted for effect of other factors*

	Adjusted prevalence (%)	χ^2	df	p Value
Crowding at age 2:				
Up to one person per room	6·7	4·25	1	<0·05
Over one person per room	10·0			
Respiratory illness up to age 10:				
No illness	7·4	5·56	1	<0·02
Illness	10·5			
Home ownership at age 36:				
Owner occupier	6·9			
Council tenant	12·7	12·41*	2	<0·001
Other	11·6			
Cigarette smoking at age 36:				
Current smoker	15·9			
Ex-smoker	5·3	71·82†	2	<0·001
Never smoked	3·3			

*Difference between council tenants and owner occupiers.
†Difference between current smokers and never smokers.

TABLE IV—*Mean peak flow rates adjusted for height in women and men at age 36 analysed by various factors*

	Women		Men	
	l/min	No	l/min	No
Crowding at age 2:				
Up to one person per room	417·9	877	560·0	833
Over one person per room	401·8	672	546·3	705
Home ownership at age 2:				
Owner occupied	422·0	363	562·0	378
Other	407·4	1182	551·8	1144
Family size at age 2:				
Up to two children	412·6	1019	557·4	1020
Over two children	407·2	440	545·7	436
Father's social class at age 4:				
Non-manual	421·6	629	561·4	620
Manual	405·0	876	550·5	878
Sleeping arrangements at age 6:				
Slept alone	415·4	1054	556·6	1021
Shared bed	401·0	448	549·9	468
Respiratory illness up to age 10:				
No illness	414·3	1142	557·3	1098
Illness	402·3	391	545·9	431
Home ownership at age 36:				
Owner occupier	417·4	1235	559·5	1213
Council tenant	385·5	251	536·1	214
Other	409·6	154	542·2	190
Cigarette smoking at age 36:				
Current smoker	408·6	549	545·4	558
Ex-smoker	415·6	545	561·8	643
Never smoked	411·4	545	554·9	419

TABLE V—*Analysis of variance of peak flow rates at age 36 expressed as mean values after adjustment for height and other factors*

	l/min	p Value
Sex:		
Women	411·2	<0·001
Men	553·8	
Crowding at age 2:		
Up to one person per room	486·8	<0·001
Over one person per room	476·7	
Respiratory illness up to age 10:		
No illness	485·0	<0·01
Illness	475·0	
Home ownership at age 36:		
Owner occupier	487·2	
Council tenant	462·7	<0·001
Other	473·7	
Cigarette smoking at age 36:		
Current smoker	478·8	
Ex-smoker	486·6	<0·05
Never smoked	480·9	

associations between environment and childhood chest illness are highly suggestive of a cause and effect relation at those ages.[7] This coupled with evidence from another study of young children, in which initial ventilatory function in those who subsequently suffered chest illnesses was similar to that of children spared such illness, lends support to the model of acquired lung damage predisposing to adult disease.[16]

If this conclusion is correct it has relevance for the future prevention of childhood chest illness and limiting subsequent adult chest disease by reducing or avoiding exposure to certain environmental influences. Currently, indoor air pollution by cigarette smoke is probably the only important factor that can readily be altered.

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Migration of gall stones

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Abstract

The factors influencing the migration of gall stones are ill understood. Altogether 331 patients undergoing cholecystectomy were studied prospectively. The diameters of the cystic and common bile ducts and of stones in the gall bladder and bile ducts were measured. Increasing pressure was applied to the freshly excised gall bladder in an attempt to evacuate stones through the cystic duct. Stones passed in 33 (60·0%) of patients with choledocholithiasis, 45 (67·2%) of patients with pancreatitis, and 7 (3·2%) of patients without either pancreatitis or choledocholithiasis. Stones migrated in 6 (3·0%) who had a normal cystic duct diameter (≤4 mm) and in 46 (32·5%) with a duct over 4 mm diameter. Common bile duct stones were often larger than the diameter of the cystic duct and when reintroduced into the gall bladder would not migrate. The passage of debris (≤1 mm) through the cystic duct bore no relation to the presence or absence of choledocholithiasis or a dilated cystic duct.

Small stones (1-4 mm diameter) must migrate to initiate and facilitate further migration; some must increase in size in the common bile duct. Increased biliary pressure consequently dilates the duct system retrogradely, allowing larger stones to follow. Patients at risk of stone migration and thereby pancreatitis and jaundice have large ducts that can be detected by ultrasound assessment.

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Introduction

Although cholecystectomy is the most commonly performed abdominal operation—over half a million are performed each year in the United States—there is a fundamental lack of understanding of the mechanism by which gall stones either leave the gall bladder or develop in the common bile duct. Such knowledge is essential in comprehending the clinical course of gall stones and their complications, choledocholithiasis, pancreatitis, and jaundice. Patients with microlithiasis (stones ≤3 mm) are more prone to develop pancreatitis, while those with medium and large gall stones are more susceptible to acute cholecystitis.[1]

Several groups of workers have shown unequivocally that gall stones may migrate and thereby cause pancreatitis,[2-8] but argument still exists about whether stones form in the common bile duct de novo[9] and nothing is known of the growth pattern of a gall stone within the common bile duct. Small stones that pass into the bile duct are clearly capable of passing through the ampulla[2,3]; this must also be true of "gravel." But what of large stones in the common bile duct? Do these pass as large stones from the gall bladder? Do they grow in the duct? Or do they reduce in size in the medium of less lithogenic bile in the duct? This study attempted to answer these questions.

Patients and methods

In a prospective study of 331 patients who were undergoing cholecystectomy for cholelithiasis at two centres the potential for stones to migrate through the cystic duct was assessed. The first 201 formed a consecutive series, the second 130 were selected to increase the number of patients with gall stone pancreatitis and choledocholithiasis. Pressure was applied digitally by squeezing the intact gall bladder immediately after excision to evacuate the contents through the cystic duct. Every attempt was made to coax stones through the duct by digital manipulation of the gall bladder, Hartmann's pouch, and duct so that any feasible migration would be recorded. Solid material >1 mm in diameter passing through the cystic duct was regarded as