Thorax 1989:**44**:620–626

Recurrent accident and emergency department attendance for acute asthma in children

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ABSTRACT Asthmatic children aged over 5 years making repeated visits to the accident and emergency department of a children's hospital were compared prospectively, on the basis of a clinical questionnaire and pulmonary function tests, with a control group of outpatients with asthma to find the reasons for their repeated attendance. Recurrent attenders (n = 145) had more severe asthma than control subjects (n = 118), with greater airway obstruction at rest (FEV_1 79% *v* 84% predicted) and bronchial lability (47% *v* 38%). Significantly more of the "emergency" group used pressurised aerosols and fewer dry powder inhalers to administer bronchodilators. There were no differences in prophylactic treatment. Seventy one per cent of parents in the emergency group had feared that their child would die during an attack, compared with 56% of control subjects. Eighty one per cent of children were self referred to the accident and emergency department. Most parents had found hospital to be the quickest means of obtaining treatment in an emergency. There were no differences between the two groups in parents' knowledge about asthma, home conditions, or social disadvantage. Although children who repeatedly attend hospital accident and emergency departments for treatment of acute attacks have more severe asthma than controls and show some deficiencies in treatment, the major determinant of attendance appeared to be the parents' conviction that appropriate treatment could not be obtained elsewhere.

Introduction

Asthma is the most common chronic illness of childhood, affecting about 10% of schoolchildren.[1] There has been a substantial increase in the number of hospital admissions for asthma in children in recent years,[2,3] and no reduction in deaths.[4] Studies of deaths from asthma in adults and children have shown failure to appreciate the severity of the attack and delay in initiating effective treatment—by patients, their families, and doctors in general practice and hospital. Many deaths from asthma are potentially avoidable.[5–7] Direct, patient initiated admission to hospital has been shown to be of value in adults with severe asthma[8] and studies in children have shown an increase in the number of asthmatic children self referred to hospital by parents, bypassing the general practitioner.[2,9] Emergency attendance at hospital provides prompt initial relief of symptoms, but may not be the most appropriate response to acute attacks in children. Hospital attendance and admission are undesirable in children unless there is no alternative. Experience in the management of asthma cannot be guaranteed in an accident and emergency department,[10] and facilities for long term follow up are unlikely to be available.

To investigate the reasons why emergency hospital attendance for acute asthma is increasing in children, we have studied a group of asthmatic children making repeated visits to the accident and emergency department of a children's hospital during an acute attack during one year. They have been compared with a group of asthmatic children attending hospital outpatients who have not required recent treatment in the accident and emergency department.

Patients and methods

The Royal Liverpool Children's Hospital (Alder Hey) is the largest children's hospital in the United Kingdom. The accident and emergency department serves a population of about 150 000 children aged under 16 years.

All children aged from 18 months to 16 years who attended the accident and emergency department for treatment of acute asthma between 1 January and 31

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Accepted 9 June 1989

December 1986 and who had also attended at least once during the preceding 12 months were eligible for the study (emergency group). Children less than 18 months old were excluded because of the difficulty of establishing a firm diagnosis of asthma in this age group. Because of the small number of children under 5 in the control group and the absence of pulmonary function data in the younger children this report is confined to children aged 5 and over.

We also recruited a control group of asthmatic children attending the hospital as outpatients who had not required emergency hospital treatment for at least a year. Control children were attending the hospital regularly at the clinics of eight consultant paediatricians, one of whom is a paediatric respiratory physician. They were recruited either on attendance at the respiratory function laboratory for routine pulmonary function tests or in response to a letter asking for volunteers distributed in the outpatient clinic.

Children were assessed on the basis of answers to questionnaires, weight and height, results of pulmonary function tests, assessments of inhaler technique, and theophylline concentrations (where appropriate). If the children were admitted interviews were carried out while they were in the ward. If they were not admitted their parents were contacted and asked to bring them to the hospital three to four weeks later. This interval was selected to allow reasonable time for return of lung function to normal yet to avoid excessive delay so that details of the attack were not forgotten. Parents were asked to bring all the treatment the child was having when they attended.

All treatment was omitted on the day of the pulmonary function tests. Airway obstruction at rest was assessed by peak expiratory flow (PEF), measured by a Wright's peak flow meter, and a computerised flow-volume loop (Micro Medical Industries) with measurement of forced expired volume in the first second (FEV_1), forced vital capacity, maximum mid expiratory flow between 25% and 75% of vital capacity, and forced expired flow at 50% and 25% of vital capacity. This was followed by a six to eight minute free running exercise challenge,[11] with encouragement to maintain a heart rate of 170–190 beats per minute. Peak expiratory flow was measured three and five minutes from the start of exercise and three, nine, and 15 minutes afterwards. The child then took his or her usual bronchodilator, inhaler technique was observed, and PEF was measured after two, five, and 10 minutes. The inhaler technique was compared with the manufacturer's instructions and graded as good, fair, or poor. The exercise test was not carried out if the resting PEF was less than 60% of the value predicted for height.

After the year's study had been completed, a postal questionnaire was sent to all parents who had taken part to ask whether they had needed to see their general practitioner as an emergency because of the child's asthma during the study year. Questionnaire replies and pulmonary function test results were compared to find differences in the severity of asthma and its treatment; home environment and socioeconomic conditions; parents' knowledge, perceptions, and fears; and general practitioners' attendance. Informed consent was obtained from parents for the pulmonary function tests to be performed and copies of all results were sent to the consultant treating the child. Ethical committee approval was obtained before the study was started.

Statistical analysis used the χ^2 test, Student's t test, and the Mann-Whitney U test (with the Statistics Program for the Social Sciences).

Results

During 1986 820 children (median age 5·5, range 1·5–16 years) made 1389 visits to the accident and emergency department of the Royal Liverpool Children's Hospital (Alder Hey) for emergency treatment of acute asthma. Of these, 323 children made two or more visits (total 835, median 4·5, range 2–16 visits) in 12 months and were eligible for inclusion in the study. Questionnaire data were obtained from 301 children (93%), of whom 145 were over the age of 5 years. A control group was recruited from outpatients clinics, of whom 118 were aged over 5 years.

The emergency group of 145 children had a mean age of 9·46 years; 75% were boys. The control group of 118 children had a mean age of 10·08 years; 70% were boys. There was no significant difference in age, sex, weight, or height between the two groups. Eighty six children (61·4%) in the emergency group were also attending an outpatient clinic at the hospital.

Table 1 *Severity of the usual and worst ever attacks in the emergency and control groups*

	Usual attacks (%)		*Worst ever attack (%)*	
	Emergency	*Control*	*Emergency*	*Control*
Wheezy but can play normally	28	35	1	3
Wheezy and dyspnoeic; able to talk	35	37	2	8
Very dyspnoeic; chest and abdominal heaving	27	18	26	36
Very tired and distressed; unable to talk	11	10	50	41
Going blue	0	0	22	12
	$p = 0·35$		$p = 0·007$	

Table 2 *Results of pulmonary function tests (mean (SD) values)* in the emergency and control groups*

	Emergency group	*Control group*	*p*
FEV_1 (% pred)	79 (19)	84 (18)	0·02
Exercise induced bronchoconstriction: % fall in FEV_1 (normal < 15%)	39 (19)	33 (21)	0·02
Bronchodilator response: % increase in FEV_1 (normal < 15%)	31 (16)	26 (16)	0·006
Lability index (normal < 20%)	47 (20)	38 (24)	0·01

*More detail on pulmonary function is available from the authors on request.

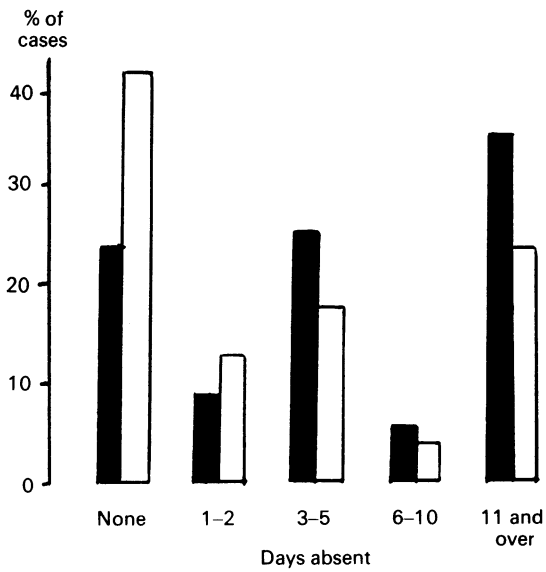
SEVERITY OF ASTHMA

Children in the emergency group had significantly more severe asthma. They developed the disease younger (mean age 3·2 years, controls 4·2 years; $p = < 0·05$) and had a history of more severe "worst ever" attacks, though there was no difference in current attacks (table 1). They had more absences from school than controls (figure). Pulmonary function tests showed the emergency group children to have greater airway obstruction at rest, exercise induced bronchoconstriction, and bronchodiltor responsiveness (table 2).

TREATMENT

The only difference in treatment that emerged was that emergency group children were significantly more likely to use a pressurised aerosol and less likely to use a dry powder inhaler to take their bronchodilator (table 3). Most families (97% of emergency group, 99% of controls) had some form of treatment in the home, and 68% and 85% respectively would treat the child as soon as he became wheezy (no significant difference). Most children (86% of emergency group, 85% of controls) were able to take their inhalers to school; the remainder were prohibited by their schools. Inhaler technique was considered adequate in 83% of emergency group children and 81% of controls. Although all the children were aged at least 5 years, some used only oral treatment (table 3). No child in either group had a supply of oral corticosteroids at home to take for a severe attack.

There were no differences between the groups in prophylactic treatment. Twenty eight per cent of emergency group children and 32% of controls took no regular treatment and some took only bronchodilators. There was no difference in the type of prophylactic drug used by the two groups (table 3). No children performed peak flow measurements at home.



Absence from school due to asthma in the last term in the emergency group (■) and the control group (□).

HOME AND SOCIAL CONDITIONS

There were no differences between the groups in potentially adverse conditions in the home. Sixty four per cent of emergency group families and 59% of controls had a parent who smoked and keeping pets was common—54% and 61% respectively, most commonly a dog. Parents often carried out extra cleaning to reduce dust in the house (73% of emergency group, 72% of controls). The number of fathers who were unemployed (23% in emergency group, 26% in control families) was similar to the male unemployment rate for Liverpool at the time of the study (25·8%, Department of Health and Social Security, March 1986). There was no difference in the social class distribution for either parent by current or past occupation. Emergency group families had less easy access to transport in a crisis, 28% having neither a car of their own nor a lift, compared with 16% of control children ($p < 0·02$).

PARENTS' KNOWLEDGE ABOUT ASTHMA

Parents in the two groups were equally well informed about asthma; 56% of both groups made an accurate assessment of the prevalence of asthma, 83% and 72% respectively knew the lungs were the organ affected and 81% and 87% that the major change during an attack was narrowing of small airways, and 87% and 75% thought that children could grow out of asthma.

Table 3 *Treatment in the emergency and control groups*

	Emergency (n = 145)		*Control (n = 118)*		
	No	*(%)*	*No*	*(%)*	*p*
ACUTE					
Oral bronchodilator	23/145	(16)	21/118	(18)	NS
Inhaled bronchodilator	121/145	(83)	96/118	(81)	NS
Pressurised aerosol	50/121	(41)	26/96	(28)	
Tube spacer	4/121	(3)	10/96	(10)	
Large volume spacer	21/121	(18)	8/96	(7)	<0·01
Dry powder inhaler	46/121	(38)	52/96	(54)	
Nebulised bronchodilator	11/121	(8)	7/11	(6)	NS
PROPHYLAXIS					
Oral bronchodilator	3/145	(3)	2/118	(2)	NS
Inhaled bronchodilator	10/145	(7)	7/118	(6)	NS
Nebulised bronchodilator	1/145	(1)	0		
Sodium cromoglycate	55/145	(38)	43/118	(36)	NS
Spinhaler	28/55	(52)	26/43	(60)	
Pressurised aerosol	16/55	(28)	15/43	(35)	NS
Large volume spacer	8/55	(15)	2/43	(5)	
Nebuliser	3/55	(5)	0		
Inhaled steroids	41/145	(28)	27/118	(36)	NS
Pressurised aerosol	12/41	(28)	2/27	(8)	
Tube spacer	9/41	(23)	5/27	(19)	
Large volume spacer	5/41	(11)	7/27	(27)	NS
Dry powder inhaler	11/41	(26)	11/27	(38)	
Nebuliser	5/41	(12)	2/27	(8)	NS
Oral steroids	0		0		
Theophyllines	38/145	(26)	20/118	(17)	NS
Good inhaler technique	103/145	(84)	87/118	(81)	NS
Mean (SD) serum theophylline concentration (μg/ml)	8 (7)		10 (6)		NS

Fewer emergency group parents thought that it was possible to reduce the frequency of attacks (54% compared with 75%; $p < 0.01$).

PARENTS' CONCERNS ABOUT ASTHMA

Parents were asked if they thought that it was theoretically possible for children to die from asthma. Similar numbers thought that it was (72% *v* 70%). Many more parents in the emergency group, however, had been afraid at some time that their own child would die—71% compared with 56% of controls ($p < 0.02$). Emergency group parents would also seek help at an earlier stage in an attack: 61% would look for help when the child was wheezy with his chest heaving but still able to talk, compared with 41% of control parents ($p < 0.01$).

ACCIDENT AND EMERGENCY DEPARTMENT ATTENDANCE DURING ATTACKS

On their most recent visit to the accident and emergency department 118 of the 145 children (81%) were self referred, compared with 43 (32%) on their first visit. The change in referral was significant (table 4). When asked where they would look for medical assistance if the child had a severe attack, 124 parents said the hospital, 13 their general practitioner, and eight either. The reasons for their choice are shown in table 5.

Despite their preference for hospital care during acute attacks, the follow up questionnaire, returned by 92 emergency group parents and 62 controls, shows that recurrent hospital attenders are still users of primary care. During the study year 31 emergency group children (34% of those replying) and 29 controls (47%) had seen their general practitioner for acute asthma (difference not significant). Emergency group children had visited the general practitioner more frequently (mean 4·0 visits) than the outpatient department (2·4 visits; $p < 0.02$).

Discussion

The results of the study show that asthmatic children who repeatedly attended the accident and emergency

Table 4 *Details of referral for first and last visit to accident and emergency department*

	First visit		*Last visit*	
Person referring	*No*	*(%)*	*No*	*(%)*
Parents	43	(32)	118	(81)
GP	51	(35)	11	(8)
Locum	27	(19)	4	(3)
GP over telephone	7	(5)	5	(4)
Other (eg teacher)	1	(0·7)	0	
Can't remember	4	(3)	0	
Child deteriorated therefore did not wait	8	(6)	5	(3)

Difference between first and last visit: $p = < 0.001$.

Table 5 *Reasons for choosing hospital accident and emergency department (AED) or general practitioner**

	No	(%)
Choose hospital: 124 parents		
GP said to go to hospital if child bad/have always been sent to AED so now go straight there	49	(40)
Quicker to go to AED than to wait for GP or locum to visit	37	(30)
Nebuliser only thing that helps	36	(29)
Little confidence in GP	26	(21)
Better facilities for treatment in hospital	14	(11)
No point calling GP because he can't do anything parents haven't done already	12	(10)
Feel safer in hospital	9	(7)
Told to come by hospital staff	7	(6)
Have nebuliser at home and need to go if that fails	5	(4)
Other reasons	11	(9)
Choose general practitioner: 13 parents		
Prefer to treat at home if possible and usually can if GP visits	5	(38)
GP very good	4	(31)
Prefer to get GP's opinion first	2	(15)
Phone GP, who says go to AED	1	(8)
Need antibiotics and can get them from GP	1	(8)
Have nebuliser at home and would only get nebuliser in AED	1	(8)
Unhappy with AED: "A lot of hassle"; doctors don't know what's wrong	1	(8)
May choose either: eight parents		
Go to AED if bad, call GP if not too bad	6	(75)
Go to GP by day, AED at night	5	(63)

*Many parents had more than one reason for their choice.

department of a children's hospital for treatment of acute attacks had more severe asthma than control subjects. They were more likely to use pressurised inhalers to deliver bronchodilators, though they received similar prophylactic treatment. Between the first and the last visit many parents had begun to go directly to hospital without the intervention of their general practitioner. Their reasons for attending hospital suggest that they had learned that it was the quickest way to obtain treatment. More emergency group parents than controls had feared at some time that their child would die during an attack and they sought medical treatment at an earlier stage.

Assessment of the severity of asthma in our two groups of children suggests that emergency group children have more severe disease, though both groups come from the more severe end of the range of asthma. Their pulmonary function test results are similar to the more severely affected Melbourne children studied by Hill.[12] Comparison with the London children reported in a community survey by Anderson[13] shows that only 12% of his children missed more than 31 days' school in a complete year; 35% of our emergency group children had missed the equivalent, more than 10 days in a single term.

Undertreatment of asthma is known to be common.[5 14] Our emergency group had more severe asthma than the controls but the only significant difference in treatment was that they used pressurised aerosols more and dry powder inhalers less than controls. Many asthmatic children and adults experience difficulty in using pressurised aerosols correctly and dry powder devices have been shown to be a more effective means of delivering bronchodilators in children.[15] Use of better inhalers might enable attacks to be treated more effectively by the child and his or her family. Although all the children in both our groups were over 5 years of age and should have been able to use some type of inhaler, some received only oral bronchodilators. No families had oral corticosteroids available for an acute attack.

There was no difference between the two groups in the amount or type of prophylactic treatment. Twenty eight per cent of the emergency group and 32% of controls took no regular treatment and some used bronchodilators only. There was no difference in the type of inhaler used. Theophyllines were commonly used but 75% of the emergency group and 50% of control children had subtherapeutic serum concentrations.

Both our groups were receiving relatively intensive treatment compared with asthmatic children in community studies. Only 21% of the children of Anderson *et al* had used a bronchodilator and 16% some form of prophylaxis during three months.[12] Storr *et al*[16] found that 4·9% of primary school children in Sussex used inhaled treatment, of whom 22% took sodium cromoglycate, and 16% inhaled corticosteroids, 2% having a home nebuliser; 2% took oral theophylline. Although the only difference between our groups was in the type of inhaler used for bronchodilators, several deficiencies in the treatment of both groups is nevertheless apparent.

Social class and environmental conditions in the home did not affect emergency attendance, though adverse social conditions have been associated with suboptimal treatment[17] and a greater risk of death from asthma.[18] Evans *et al* reported an excess of families who smoked among hospital attenders for acute asthma.[19] Parental smoking was common in both our groups, but no more so in emergency group families.

Parents in both our groups showed good basic knowledge about asthma, and most were confident that they could judge when medical help was needed during an attack. Conway and Littlewood found that parents' assessment of severity corresponded well with that of the admitting doctor.[20]

Most parents in both groups were aware that asthma could be fatal. A far greater proportion of emergency group parents had feared at some time that their own child was about to die than had our controls or the 50% of Melbourne families reported by Reddihough *et al*.[21] The study by Evans *et al* of emergency room attendance by asthmatic children in

New York[19] showed that parents' fear that the child might die during the current attack was not associated with an increased number of visits, but they did not inquire about previous attacks. Our emergency group children had similar current attacks to those of controls, but a history of more severe "worst ever" attacks. In a case-control study of asthma deaths in New Zealand, Rea *et al*[22] have shown that those who died were more likely than community controls to have needed emergency room treatment or admission in the previous year and more likely than hospital and community controls to have had a life threatening attack in the past. Our group of recurrent hospital attenders can therefore be considered to be a high risk group and the parents' fears cannot be discounted.

Frequent attacks due to inadequate prophylaxis and greater parental anxiety as a result of severe attacks in the past do not alone explain why children attend accident and emergency departments repeatedly during acute attacks. There was a substantial change from general practitioner referral to self referral between the first and most recent visit by our emergency group children. Anderson *et al*[9] reported a fivefold increase in self referrals to London hospitals from 1970 to 1978, by which time 44% of children admitted were self referred. Many of the parents in our emergency group had been told by their general practitioner to go to hospital if the child had a bad attack or had found his treatment inadequate or the wait for a visit unacceptably long. Some children had a home nebuliser but only 2% had received nebulised treatment from their general practitioner, though nebulisers can be used successfully in general practice.[23] A study of the use of nebulisers in general practice in Liverpool[24] shows that only 32% of practices sampled had a nebuliser and that the deputising service, which was used by 91% of practices, did not use nebulisers at all. Some parents in our study stated that they came to hospital to get treatment by nebuliser. Possibly the desire to obtain nebuliser treatment for their children, combined with awareness that this is unlikely to be available outside hospital, is one of the factors that contributes to accident and emergency department attendance.

In conclusion, our group of children who repeatedly come to the accident and emergency department during acute attacks of asthma were from a severely affected group who have a history of frightening attacks. They were more likely to take their bronchodilators by pressurised aerosol and may thus have obtained less good relief than the control children. Their parents were well informed about asthma and had feared at some time that the child would die during an attack. They sought help earlier than controls and many had learned from experience to go to hospital when treatment at home had failed. Better long term management of asthmatic children, including careful choice of a suitable inhaler, should reduce the number of attacks and enable a greater proportion to be treated successfully by parents. When treatment at home fails, prompt, effective treatment by the general practitioner, which commands the confidence of parents, could reduce the need for emergency hospital treatment. Without such changes it is likely that the steep increase in hospital attendances will continue.

We thank Dr David Downham and Dr Jane Hutton for statistical advice and Mr Chris West for carrying out the computer analysis of data.

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