

What predicts poor collection of medication among children with asthma? A case-control study

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What predicts poor collection of medication among children with asthma? A case-control study. L. Irvine, I.K. Crombie, E.M. Alder, R.G. Neville, R.A. Clark. ©ERS Journals Ltd 2002.

ABSTRACT: Compliance with asthma medication is recognised to be a problem. Acquisition of medication is the first step towards compliance. Factors predicting poor collection of prophylactic medication were investigated.

A case/control study was conducted. Cases were children who had had at least two consultations for poorly controlled asthma in 1 yr and collected prescriptions of prophylactic medication irregularly. Controls were children whose prescriptions were collected as instructed.

Levels of knowledge about asthma and asthma medication were high in both groups. Parents of cases were more likely to perceive their child's asthma to be moderate or severe and more likely to report that their child's asthma was not well controlled. They reported more night-time symptoms, exercise symptoms and school absence. Parents of cases were less likely to report that administering inhalers was part of the evening routine. They were less likely to perceive their child's prophylactic medication to be very effective and more reluctant to administer prophylactic medication.

Some parents may decide to undertreat their children, although lack of organised routine may contribute to poor compliance. Parents need guidance on interpreting symptoms and support in establishing routines for the administration of medication.
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Many children with asthma suffer considerable morbidity despite the availability of effective treatments [1]. Asthma remains a common reason for admission to hospital [2] and consultations with the general practitioner (GP) [3]. One explanation for this is that asthma sufferers do not take medication as prescribed [4, 5]. Adherence to prescribed regimens of inhaled corticosteroids have been shown to decrease the risk of hospitalisation [6] and death due to asthma [7]. Many GP practices have established asthma clinics and a great deal of effort has been invested in the education of patients regarding the management of asthma [8, 9]. Asthma medications are available in a variety of delivery systems, thus ensuring that inhaled medication is available to all patients [10]. Despite this improved knowledge, awareness of the disease and availability of effective treatments, compliance with medication has not improved [11, 12].

Parental and childhood factors which influence compliance with medication were investigated. The present study was designed to investigate poor compliance with medication that was associated with poor control of asthma symptoms. Acquisition of medication is the first step towards compliance with prescribed medication. Inappropriate collection of prescribed

medication that was associated with exacerbations of asthma was therefore used to assess compliance.

Materials and methods

The study was approved by the Fife Medical Research Ethics Committee. Twenty-nine general practices in Fife, Scotland, provided lists of patients between the ages of 2–12 yrs on prophylactic medication for asthma. Data were extracted from the GP asthma registers, repeat-prescribing systems and patient case records. Details of the drugs prescribed, dose and frequency of administration, inhaler devices and dates of issue of prescriptions were recorded. In addition, a summary of every contact for asthma over a period of 1 yr was recorded.

Study subjects

Cases were children who had had at least two patient-initiated contacts with the GP for poorly controlled asthma over a 1-yr period and had not collected prescriptions for medication in accordance with the GP's instructions. The expected frequency

of collection was derived from the total amount prescribed and the daily dose [4, 5]. Controls were children who collected enough prescriptions for asthma medication in the 1-yr period to ensure that they could adhere to the GP's instructions; they were matched to the cases by GP practice, age (within 2 yrs) and sex. These entry criteria were used to ensure the recruitment of two groups, one with children who definitely did not use enough medication to control their asthma and the second with children who appeared to have complied with therapy.

The case records of 1,266 children (60% male) aged 2–11 yrs were reviewed. Of these, 431 children fitted the criteria for cases or controls. A further 212 children did not collect prescriptions in accordance with the GP's instructions but had had less than two exacerbations recorded in their case records and were therefore excluded. For 623 of the children, it could not be determined whether they were complying with the intended therapy. The details are to be published elsewhere, but, briefly, the main reasons were that many were not on continuous medication (433) and, for others, there was inadequate information to assess compliance (324). These numbers do not add up to 623 since some children could be assigned as non-compliant for more than one reason.

Of the 431 children assigned as cases and controls, 264 could be organised into matched pairs (*i.e.* 132 pairs). The remaining 167 children were excluded because no match could be identified within the practice. Of the 132 matched pairs, 21 were excluded because interview data could not be obtained on one member of the pair, resulting in 111 of the 132 pairs being available for analysis. The children were aged 2.4–12.1 yrs (mean 8.0 yrs) (one child was >12 yrs due to postponement of interview) and 138 (62%) were male, reflecting the sex difference in childhood asthma [13].

The parent who was the main carer of the child was invited to take part in the study. Families were visited at home and the participating parent given a semi-structured interview in order to ascertain knowledge and beliefs about asthma and its management as well as providing information on the management of the child's asthma. The interviewer was blind to case/control status. Levels of knowledge were assessed from parents' responses to statements about asthma and asthma medications based on a validated questionnaire [14].

Statistical methods

Factors which predicted compliance were assessed through conditional logistic regression analysis, in which the case/control status (coded 1 or 0) was the dependent variable. The analysis took account of the matching of cases and controls.

Results

Demography

The groups were similar in terms of sociodemographic characteristics. Almost all of the respondents

were mothers (91% of cases, 92% of controls) and the majority were married (78% of cases, 84% of controls). Slightly more parents of those in the control group had a professional qualification (24% of cases, 28% of controls). In both groups, one-third of parents were in manual occupations. More of the index parents in the control group were in full-time employment (27% compared with 20% of cases) and more of the control group lived in owner-occupied accommodation (62% compared with 54% of cases). None of these differences reached significance.

The childrens' asthma

The poor compliers (cases) were significantly more likely than the controls to be prescribed high-dose inhaled corticosteroids (23% of cases, 10% of controls; odds ratio (OR) 3.00; 95% confidence interval (CI) 1.28–7.06). Parents of cases were twice as likely to report their child's asthma as being moderate or severe (44% of cases, 28% of controls; OR 2.13; 95% CI 1.17–3.85) and more than four times more likely to report control of the asthma as moderate or poor (OR 4.42; 95% CI 1.43–13.64).

Administration of inhalers

There was less-organised routine within the home among the cases (table 1). Parents of cases were almost twice as likely to report that giving inhalers was not part of the normal evening routine (OR 1.85, 95% CI 1.07–3.19). Among families with two parents, cases were much more likely to have only one parent responsible for the supervision of evening inhalers. Children who were poor compliers (cases) were less likely to prompt their parents to administer the inhaler.

Morbidity

Parents of the cases reported substantially more morbidity than those of controls, both at the time of interview and during periods when they considered the child's asthma to be troublesome (table 2). There was a two-fold increase in the odds of reporting current night-time symptoms and a three-fold increase in night-time symptoms when the child's asthma was troublesome. There was also a three-fold increase in the odds of reporting frequent exercise symptoms when the asthma was troublesome. The chance of school absence in the 6 months prior to the interview was almost three times higher for cases.

Self-management strategies

The majority of parents in both groups reported that the children attended an asthma clinic (68% of both groups). Only one-half of the children aged >5 yrs used peak flow meters (51% of cases, 48%

Table 1. – Administration of inhalers

	Cases n	Controls n	Chi-squared	df	OR for factor level	95% CI
Inhalers part of morning routine			1.04	1		
Yes	63	71			1.00	
No	46	38			1.30	0.78–2.14
Inhalers part of evening routine			5.15	1		
Yes	57	74			1.00	
No	51	34			1.85	1.07–3.19
Supervision of evening inhalers (two-parent families)			7.13	2		
Both parents	16	29			1.00	
Mother only	45	36			2.72	1.14–6.50
Father only	9	5			4.39	1.07–18.10
Child prompts parents to administer prophylactic			13.37	3		
Always	18	28			1.00	
Usually	16	20			1.53	0.57–4.11
Sometimes	29	39			1.67	0.66–4.22
Never	45	21			4.29	1.65–11.14

df: degrees of freedom; OR: odds ratio; CI: confidence interval.

Table 2. – Reported morbidity

	Cases n	Controls n	Chi-squared	df	OR for factor level	95% CI
Current night-time symptoms			5.78	1		
No	57	74			1.00	
Yes	54	37			2.00	1.12–3.58
Frequency of night-time symptoms when asthma is troublesome			9.02	2		
None	13	29			1.00	
Once or twice per week	27	26			2.50	1.00–6.23
Frequently	58	43			3.33	1.43–7.74
Frequency of exercise symptoms when asthma is troublesome			12.22	2		
None	20	37			1.00	
Once or twice per week	22	26			1.70	0.72–3.98
Frequently	53	32			3.78	1.66–8.63
School absence due to asthma in past 6 months			9.79	2		
None	50	73			1.00	
<1 week	33	23			1.97	1.01–3.82
>1 week	27	14			2.82	1.27–6.27

df: degrees of freedom; OR: odds ratio; CI: confidence interval.

of controls), and just over one-half of these would increase their medication in response to a low reading (51% of cases, 57% of controls). Few children used written self-management plans (14% of cases, 10% of controls).

The cases were more likely to consider use of rescue medication for an exacerbation of asthma, although the difference was not significant. More of the cases used nebulised β_2 -agonists (13% compared with 5% of controls; OR 3.03; 95% CI 0.97–9.09) and oral corticosteroids (20% compared with 12% of controls; OR 2.12; 95% CI 0.91–5.00).

Efficacy of medications

The majority of parents in both groups believed that asthma medications were effective (table 3). Almost all parents agreed that asthma medication could prevent an asthma attack if given regularly and on time.

Further, >84% of both groups believed that it was important to administer the prophylactic medication even when the child was asymptomatic. However, when parents were asked to assess the efficacy of their child's current medication, parents of cases were twice as likely to report that their child's current prophylactic medication was not very effective (33% of cases, 17% of control; OR 2.29; 95% CI 1.22–4.28). Further, more of the parents of cases reported a reluctance to administer the prophylactic inhaler (15% compared with 6% of controls; OR 3.00; 95% CI 1.09–8.25). In contrast, no difference was observed between parents of cases and controls in the perceived efficacy of the bronchodilator. Parents of cases reported a greater reluctance to use the bronchodilator but this difference was not significant.

Almost all parents agreed that their child would continue to need medication for the next 3 months (96% of cases, 95% of controls). More of the parents

Table 3. – Parental beliefs about asthma medication and perceived efficacy of current medication

	Cases n	Controls n	Chi-squared	df	OR for factor level	95% CI
Asthma medication is likely to prevent an attack if given regularly and on time			0.14	2		
Disagree	3	3			1.00	
Unsure	3	4			0.75	0.08–6.71
Agree	105	104			1.00	0.20–4.95
It is important to use the preventative inhaler even when my child does not have symptoms			0.68	2		
Disagree	10	8			1.00	
Unsure	8	6			1.08	0.25–4.71
Agree	92	96			0.76	0.28–2.05
Perceived efficacy of the prophylactic			7.24	1		
Very effective	74	92			1.00	
Somewhat effective	37	19			2.29	1.22–4.28
Perceived efficacy of the bronchodilator			0.02	1		
Very effective	52	51			1.00	
Somewhat effective	59	60			0.96	0.55–1.68
Reluctant to use prophylactic			5.23	1		
No	94	104			1.00	
Yes	17	7			3.00	1.09–8.25
Reluctant to use bronchodilator			1.52	1		
No	92	98			1.00	
Yes	16	10			1.67	0.73–3.81
My child is likely to have an asthma attack in the next three months			6.28	2		
Disagree	21	34			1.00	
Unsure	45	47			1.54	0.75–3.14
Agree	45	30			2.50	1.18–5.27
Even when my child is well I worry about him/her having an asthma attack			0.08	2		
Disagree	65	67			1.00	
Unsure	3	3			1.00	0.02–4.95
Agree	43	41			1.09	0.62–1.91

df: degrees of freedom; OR: odds ratio; CI: confidence interval.

of cases anticipated that their child would suffer from an asthma attack in the next 3 months (OR 2.50; 95% CI 1.18–5.27). However, there was no difference between cases and controls in the proportion of parents who reported worrying about the possibility of an asthma attack when the child was well (39% of cases, 37% of controls).

Knowledge

Levels of knowledge about asthma and asthma medications were high in both groups. More than 70% of parents from both groups responded appropriately to eight of the 12 questions (table 4). Topics where there was uncertainty were the role of antibiotics in

Table 4. – Proportion of parents giving an appropriate response to questions in asthma knowledge questionnaire

	True/false	Correct response given %	
		Cases	Controls
Asthma can be a serious disease	T	95	96
More than one in 10 children will have asthma at some time during childhood	T	72	73
Children with asthma have abnormally sensitive air passages in their lungs	T	71	78
Wheeze may be due to muscles tightening in the air passages of the lung	T	72	82
Wheeze may be due to swelling in the air passages in their lungs	T	56	69
Most children with asthma will have poor growth	F	71	70
Children with frequent asthma should have preventative drugs	T	89	87
Inhaled steroids are the most common treatment for asthma	T	89	87
Medication can help but cannot cure asthma	T	93	92
Inhaled steroids have fewer side effects than other drugs	T	39	41
Children can become addicted to their asthma drugs	F	68	66
Antibiotics are important in the management of asthma	F	36	49

T: true; F: false.

asthma, whether inhaled corticosteroids have fewer side-effects and whether wheeze may occur due to inflammation of the airways.

Discussion

The present study provides important insight into how parents manage asthma in their children. Regular use of medication is more likely when the administration of inhalers is incorporated into the daily routine. Compliance is also enhanced if both parents and the child take responsibility for administering the inhaler. Good compliance may occur because the whole family is more involved or the daily routine prompts parents and children to use the medication [15]. This finding may provide the mechanism underlying a previous report that children with more cohesive and organised families exhibit better asthma control [16].

Parents of cases were reluctant to use regular inhaled prophylactic medication because they were less certain about its efficacy for their child [17]. This is not simply an aversion to steroids [18], since these parents were much more likely to use courses of high-dose oral steroids. Parents appear to be more apprehensive about the continuous use of medication than they are about short courses of high-dose oral corticosteroids. This supports the findings of a recent qualitative study that patients prefer to manage asthma as an intermittent acute disorder [19].

A finding of major importance is that the parents of the cases reported substantially more morbidity than those of the controls. This indicates that a failure to use medication appropriately is not simply the result of failure to recognise symptoms [20]. Instead, the parents appear to prefer to treat symptoms as they arise with rescue medication. One explanation for the reluctance to use regular prophylactic medication could be that many of the parents of cases reported that their children had periods when they were asymptomatic (data not shown). If a child remains symptom-free for a period without treatment, there is a strong incentive to stop taking regular medication [21].

Several factors were found to be unassociated with compliance. Poor compliance has previously been linked to lower social class, level of education and psychosocial factors [22–24]. However, in the present study, there was no association between compliance and the occupation or educational attainment of the head of the household or with housing tenure. Poor compliance was not due to lack of knowledge about asthma and the role of medication, as knowledge was high in both groups. Education has been one of the main objectives of asthma clinics in recent years [25] and it is clear that parents are now given enough information. Inappropriate use of medication, however, is not related to knowledge and understanding of the disease [26, 27]. This may explain the conflict observed between knowledge of asthma medication and actions taken by parents.

A potential limitation of the present study is that, although it is known that prescriptions for the control

children were collected regularly, it is not known that they used their inhalers regularly. However, it would seem unlikely that parents would collect prescriptions so regularly if they did not intend their child to take the medication.

In summary, current educational activities provide sufficient information for parents. However, actions and intentions regarding treatment of their child's asthma are often in conflict with their knowledge about the disease and its management. Several factors appear to influence noncompliance, including concerns about inhaled corticosteroids, lack of organised routine, preference to treat asthma symptomatically rather than use prophylaxis, and acceptance or tolerance of asthma symptoms. Some parents may make a conscious decision to undertreat their children, possibly as a means of minimising the amount of medication administered. Parents need guidance on the interpretation of symptoms, discussion as to acceptable levels of medication use and support in the establishment of routines for treatment administration to control their child's asthma.

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References

1. Powell C, Primhak R. Asthma treatment, perceived respiratory disability, and morbidity. *Arch Dis Child* 1995; 72: 209–213.
2. Anderson H, Butland B, Strachan D. Trends in prevalence and severity of childhood asthma. *BMJ* 1994; 308: 1600–1604.
3. Anderson H. Epidemiology of asthma. *Br J Hosp Med* 1992; 47: 99–102.
4. Warner J. Review of prescribed treatment for children with asthma in 1990. *BMJ* 1995; 311: 663–666.
5. Barnes P, Jonsson B, Klim J. The costs of asthma. *Eur Respir J* 1996; 9: 636–642.
6. Donahue J, Weiss S, Livingston J, Goetsch M, Greinder D, Platt R. Inhaled corticosteroids and the risk of hospitalisation for asthma. *JAMA* 1997; 277: 887–891.
7. Suissa S, Ernst P, Benayoun S, Baltzan M, Cai B. Low-dose inhaled corticosteroids and the prevention of death from asthma. *N Engl J Med* 2000; 343: 332–336.
8. Charlton I, Charlton G, Broomfield J, Campbell M. An evaluation of a nurse-run asthma clinic in general practice using an attitudes and morbidity questionnaire. *Fam Pract* 1992; 9: 154–160.
9. Dickinson J, Hutton S, Atkin A, Jones K. Reducing asthma morbidity in the community: the effect of a targeted nurse-run asthma clinic in an English general practice. *Respir Med* 1997; 91: 634–640.
10. Powell C, Everard M. Treatment of childhood asthma. Options and rationale for inhaled therapy. *Drugs* 1998; 55: 237–252.
11. Ordóñez G, Phelan P, Olinsky A, Robertson C. Preventable factors in hospital admissions for asthma. *Arch Dis Child* 1998; 78: 143–147.

12. Leickly F, Wade S, Crain E, Kruszon-Moran D, Wright E, Evans R. Self-reported adherence, management behavior, and barriers to care after an emergency department visit by inner city children with asthma. *Pediatrics* 1998; 101: E8.
13. Sears M, Burrows B, Flannery E, Herbison G, Holdaway M. Atopy in childhood. I. Gender and allergen related risks for development of hay fever and asthma. *Clin Exp Allergy* 1993; 23: 941–948.
14. Fitzclarence C, Henry R. Validation of an asthma knowledge questionnaire. *J Paediatr Child Health* 1990; 26: 200–204.
15. Clark N, Evans D, Zimmerman B, Levison M, Mellins R. Patient and family management of asthma: theory-based techniques for the clinician. *J Asthma* 1994; 31: 427–435.
16. Meijer A, Griffioen RW, van Nierop JC, Oppenheimer L. Intractable or uncontrolled asthma: psychosocial factors. *J Asthma* 1995; 32: 265–274.
17. Chan P, DeBruyne J. Parental concern towards the use of inhaled therapy in children with chronic asthma. *Pediatr Int* 2000; 42: 547–551.
18. Russell G. Inhaled corticosteroid therapy in children: an assessment of the potential for side effects. *Thorax* 1994; 49: 1185–1188.
19. Jones A, Pill R, Adams S. Qualitative study of views of health professionals and patients on guided self management plans for asthma. *BMJ* 2000; 321: 1507–1510.
20. Ferguson AE, Gibson NA, Aitchison TC, Paton JY. Measured bronchodilator use in preschool children with asthma. *BMJ* 1995; 310: 1161–1164.
21. Keeley D, Silverman M. Are we too ready to diagnose asthma in children? *Thorax* 1999; 54: 625–628.
22. Jones P. Health status, quality of life and compliance. *Eur Respir Rev* 1998; 8: 243–246.
23. Apter A, Reisine S, Affleck G, Barrows E, ZuWallack R. Adherence with twice-daily dosing of inhaled steroids. Socioeconomic and health belief differences. *Am J Respir Crit Care Med* 1998; 157: 1810–1817.
24. Rand C, Butz A. Psychosocial and behavioral risk factors in asthma management. *Semin Respir Crit Care Med* 1998; 19: 603–611.
25. Partridge M. Asthma: lessons from patient education. *Patient Educ Couns* 1995; 26: 81–86.
26. Tetersell MJ. Asthma patients' knowledge in relation to compliance with drug therapy. *J Adv Nurs* 1993; 18: 103–113.
27. Kolbe J, Vamos M, James F, Elkind G, Garrett J. Assessment of practical knowledge of self-management of acute asthma. *Chest* 1996; 109: 86–90.