Sleep and psychological disturbance in nocturnal asthma

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Abstract

Subjective and objective sleep disturbance was studied in children with nocturnal asthma. Relations between such disturbance and daytime psychological function were also explored, including possible changes in learning and behaviour associated with improvements in nocturnal asthma and sleep. Assessments included home polysomnography, parental questionnaires concerning sleep disturbance, behaviour, and mood and cognitive testing. Compared with matched controls, children with asthma had significantly more disturbed sleep, tended to have more psychological problems, and they performed less well on some tests of memory and concentration. In general, improvement of nocturnal asthma symptoms by changes in treatment was followed by improvement in sleep and psychological function in subsequent weeks. The effects of asthma on sleep and the possible psychological consequences are important aspects of overall care.

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Asthma is the most common chronic illness of childhood and it is possibly increasing in its prevalence and severity.¹ Sleep disturbance as a consequence of nocturnal asthma symptoms has been a neglected area,² and only recently has the extensive problem of night waking in people with asthma been highlighted. Disturbed overnight sleep and daytime sleepiness has been reported in many adults with asthma,³ and a nationwide, self report survey of school age children with asthma in the UK found that 34% were waking at least once a week as a result of coughing, wheezing, or breathlessness, and 5% reported such disturbance every night.⁴ Physiological sleep laboratory assessments of adult patients with asthma have provided some objective evidence of poor quality sleep.⁵⁻⁷ Compared with healthy control subjects, in general, patients were found to spend a greater time awake at night with less than usual amounts of deep non-rapid eye movement (NREM) sleep, otherwise called slow wave sleep (SWS). The findings in younger patients have been inconsistent. Kales and colleagues⁸ reported results similar to those in adults, but a further laboratory based study on adolescents with well controlled asthma demonstrated normal sleep architecture.⁹

Although night waking is beginning to be recognised as a common problem among children with asthma, its exact nature and consequences remain unclear. When questioned about the after effects of night waking, 59% of children with asthma reported that they felt sleepy the next day in class and 51% felt that they paid less attention than they should.⁴ Assessment of adults with nocturnal asthma and disturbed sleep has objectively demonstrated impairments on tests of attention, concentration, visual coordination, and mental flexibility, in comparison with healthy controls.⁷ Indeed, a large body of evidence indicates that sleep disturbance, in various contexts, results in a variety of cognitive impairments and behavioural problems in adults¹⁰ and in children.^{10A} Many of these changes are similar to those that have been described in children with asthma, namely spatial, visuomotor and memory deficits,¹¹ depression, and anxiety.¹² In particular, they are analogous to the behavioural problems described in children with obstructive sleep apnoea, where sleep is also repeatedly disturbed,¹³ and some improvements in learning and behaviour have been reported following successful treatment of this disorder.¹⁴ Therefore, it is likely that sleep disturbance could (at least) exacerbate existing cognitive and behavioural difficulties of children with nocturnal asthma. More information on these various points is required.

The aims of the present study were to answer the following questions: (1) What are the subjective and physiological sleep characteristics of a sample of children with symptoms of nocturnal asthma? (2) What psychological problems are described in this group? (3) What changes regarding sleep and daytime psychological function are associated with an improvement in their nocturnal asthma?

Methods

DESIGN

The study was conducted in two phases.

Phase 1

The nature and extent of sleep disturbance, cognitive impairment, and problem behaviour was assessed in a group of children with nocturnal asthma symptoms and compared with a group of healthy control children and (regarding sleep physiology variables) normative data for home sleep recordings.

Phase 2

The children with nocturnal asthma were reassessed on the same variables after their night time symptoms had been treated, to examine

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the effect of improved nocturnal asthma control on sleep, daytime cognition, and behaviour.

In principle, comparison of children with asthma with or without sleep problems might have distinguished between the psychological effects of asthma and sleep disturbance. However, the difficulties of doing this seem considerable. To permit a fair comparison, the two groups of children with asthma would need to have been so carefully matched for type and severity of their asthma (and other relevant variables) as to be unfeasible with the numbers of children available. Also, advance identification of asthmatic children without sleep problems appears to be very difficult. In a preliminary phase of the present investigations, when objective sleep measures were obtained for seven children for whom there were no parental reports of sleep disturbance, no significant differences were found between them and asthmatic children whose parents had complained of sleep problems, for any of the physiological sleep parameters described later. This suggests that the usual clinical estimates of sleep disturbance in children with asthma, based on parental reports alone, may be far too low and an unreliable guide in identifying children with asthma who sleep well.

Physiological sleep recordings were not performed on the healthy control children in phase 1 for whom the other information was collected in view of the demands already made on them. Instead, use was made of recently compiled normative data (Stores *et al.*, unpublished data, 1998). From this database, it was possible to make up asthmatic child-healthy child pairs, matched for sex and for age to three months on average (maximum 10 months).

This study was viewed as essentially exploratory in nature but appropriate because of the relative neglect of the subject matter. It was not an anti-asthma treatment study (that is, to assess the effectiveness of the changes of treatment undergone by the children concerned), for which a very different research design would have been required. The changes of anti-asthma treatment were carried out in response to clinical needs. Therefore, for whatever purpose, withholding treatment of likely established effectiveness (or withdrawing it for the purposes of the study) would not have been justified.

The study was approved by the local research ethics committee.

SUBJECTS

Subjects were recruited from consecutive patients attending respiratory clinics at the John Radcliffe Hospital in Oxford and the Royal Berkshire Hospital, Reading, in whom night time asthma symptoms and waking were reported by parents and children. Twenty one patients were recruited initially for phase 1 of the study (10 boys, 11 girls; mean age, 10 years 8 months; range, 5–16 years) and 15 continued to phase 2. Of the six who did not proceed, two were excluded because of spontaneous improvement in symptoms, one did not wish to receive any further medication, one was

experiencing severe emotional problems related to school so that he did not wish to continue with the study, and two had such an exacerbation of symptoms during the first part of the study that they did not wish to proceed.

At baseline, all of the children were receiving prophylactic medication (13 beclomethasone dipropionate; five budesonide; two fluticasone propionate; one sodium chromoglycate). All children were also using relief bronchodilators (17 salbutamol; four terbutaline sulphate). Despite these treatments, all of the children continued to have night time asthma symptoms.

Eighteen healthy control subjects were recruited by the teachers of the children with asthma. The healthy control children (seven boys; 11 girls) had a mean age of 10 years 11 months. None had any serious physical or psychiatric disorder.

ASSESSMENTS

Asthma severity

Subjective reports were recorded in the respiratory clinics of the number of nights that children with asthma were waking, whether exercise was limited, and whether they had lost time at school because of their asthma. Spirometry was also performed and FEV₁ (forced expiratory volume in one second) and FEF_{25–75} (forced expiratory flow from 25% to 75% of lung volume) were recorded as a percentage of that predicted for each child's height.

The children with asthma recorded morning and evening peak expiratory flow rates (PEFRs) throughout the study using a mini-Wright PEFR meter. Their mean PEFR for the previous two weeks was calculated at each assessment and expressed as a percentage of that predicted for each child's height. The diurnal variation in each child's PEFR was also computed. This was achieved by calculating the difference between morning and evening PEFR and expressing it as a percentage of the mean PEFR for each day. The mean percentage difference was then calculated for before and after treatment.

Polysomnography

Overnight sleep physiology was monitored for one night on each assessment at home using the Oxford Medilog 9200 ambulatory monitoring system.¹⁵ Electroencephalogram (EEG) (C₄–A₁), submental electromyogram (EMG), and electro-oculogram (EOG) (right and left outer canthi–A₂) were recorded to enable conventional sleep staging according to Rechtschaffen and Kales criteria¹⁶ in the manner used by Coble *et al.*¹⁷ This produced the following sleep variables for analysis: actual sleep time; sleep efficiency (the amount of time that the patient is actually asleep as a percentage of the total sleep period—initial sleep onset to final awakening); sleep latency (interval between final settling in bed and onset of sleep); number of awakenings; amount of NREM sleep stages 1 and 2, and 3 and 4 combined as SWS, as percentages of the total sleep period; REM sleep latency (interval from sleep onset to first

Table 1 Home polysomnographic findings and parental ratings of child's sleep quality impairment and daytime sleepiness: children with asthma at baseline ($n = 21$) compared with sex and age matched controls ($n = 18$)

	Children with asthma	Controls	p value
<i>Polysomnography</i>			
Actual sleep time (minutes)	515.5 (453.5–566.8)	538.0 (465.4–586.5)	NS
Sleep efficiency (%)	93.8 (89.0–97.0)	98.0 (97.3–98.4)	< 0.01
Sleep latency (minutes)	16.5 (11.8–19.6)	13.0 (10.5–16.0)	NS
Number of awakenings < 2 minutes	13 (8–17)	1 (0–2.5)	< 0.01
Number of awakenings > 2 minutes	4 (2–7)	1 (0–2)	< 0.01
NREM stage 1 (%)	5.9 (3.7–7.6)	4.8 (4.2–8.6)	NS
NREM stage 2 (%)	24.5 (18.2–31.7)	30.4 (22.7–33.6)	NS
NREM stage 3 and 4 combined (slow wave sleep) (%)	36.6 (30.3–54.6)	44.1 (33.8–55.3)	NS
REM latency (minutes)	100.5 (56.8–142.4)	113.0 (73.0–151.5)	NS
REM sleep (%)	21.5 (16.5–27.0)	20.0 (16.0–23.0)	NS
<i>Parental ratings</i>			
Impairment of sleep quality (%)	33.0 (21.0–52.0)	0.0 (0.0–5.0)	< 0.01
Daytime sleepiness (%)	19.0 (10.0–33.0) (2)	14.0 (5.0–19.0) (1)	< 0.05

Results expressed as median (interquartile range) (any missing values).
NREM, non-rapid eye movement.

appearance of REM sleep); and percentage of REM sleep. As a further refinement of sleep disruption, awakenings were divided into short awakenings of less than two minutes and awakenings longer than two minutes.

Subjective impairment of sleep quality and daytime sleepiness

The children's mothers completed a modified version of the Simonds and Parraga children's sleep questionnaire¹⁸ for the preceding month. A number of items are related specifically to impairment in the quality of the child's sleep: night waking, restless sleep, tiredness on waking, bad mood in the morning, daytime sleepiness, and daytime underfunctioning. Each of these items is rated either on a five point scale, with frequencies ranging from "never" to "every night", or answered "yes/no". The responses are rated and summed to produce a composite score of sleep quality. This is expressed as a percentage with 0% representing very good sleep quality and 100% indicating very impaired sleep quality. Four weeks after treatment change, the mothers were also asked to rate how their child's sleep

had altered over the preceding two weeks; they answered either "better", "about the same", or "worse".

Daytime sleepiness was assessed using a modified version of the Epworth sleepiness scale.¹⁹ On a scale from 0 to 3, the mothers rated the likelihood of their child falling asleep in seven situations, based on their behaviour in the previous month. A distinction is made between dozing off and simply feeling tired. Scores are summed to produce an overall rating of sleepiness, which is converted to a percentage, with 0% indicating no evidence of daytime sleepiness and 100% suggesting extreme sleepiness.

Cognitive function

An approximately one hour long battery of cognitive tasks (see appendix) was given to all children in the study. The battery had been used previously by one of the authors (GS),²⁰ and the tasks were chosen for their reliability, acceptability to children, relevance to children's daily lives, and expected sensitivity to sleep loss. The battery included tests of visuo-motor coordination, memory (short term auditory, immediate, and delayed recall), and attention (focal and sustained). Before testing, children underwent a practice session in an attempt to eliminate practice effects.

Mood

Children completed the well established and psychometrically assessed children's depression inventory.²¹ This consists of 27 items that cover a range of depressive symptoms. Each item presents three choices, scored from 0 to 2 in the direction of increasing psychopathology. Therefore, overall scores can range from 0 to 54.

Daytime behaviour

The Conners's parent rating scale²² was used with reference to each child's behaviour over the past month. The scale, which is well established and psychometrically acceptable, lists 48 behaviours, each of which is rated on a four point scale from "not at all" to "a lot/very much", according to how often the child is seen exhibiting that behaviour. From this information, factor scores can be derived relating to anxiety, conduct problems, hyperactivity/impulsivity, difficulty with learning (problems of attention and distractibility), and psychosomatic symptoms. In order that scores across factors can be compared directly (different numbers of items constitute different factors), the total score for each factor is divided by the number of items in that factor. Scores on each factor can range from 0 to 3.

PROCEDURE

Phase 1

Following basic clinical assessments at home, the Medilog sleep recording equipment was attached to the child in the afternoon by the recordist member of the team (AJE). The system was then removed by the parents in the morning as soon as the child awoke. The recordist made a second home visit that afternoon and the child performed the battery

Table 2 Mood and behaviour of group with asthma at baseline ($n = 21$) compared with controls ($n = 18$)

	Children with asthma	Controls	p value
Children's depression inventory	9.5 (5.3–21.3) (2)	6.0 (3.0–10.0) (1)	< 0.05
<i>Conners' scale</i>			
Anxiety	0.5 (0.5–1.3)	0.5 (0.2–0.8)	NS
Conduct problem	0.6 (0.3–1.5)	0.2 (0.1–0.7)	NS
Hyperactivity/impulsivity	1.3 (0.4–2.4)	0.5 (0.3–1.3)	NS
Learning problem	1.0 (0.3–1.8)	0.3 (0.0–0.6)	< 0.01
Psychosomatic symptoms	0.8 (0.4–1.1)	0.3 (0.0–0.3)	< 0.001

Results expressed as median (interquartile range) (any missing values).

Table 3 Physiological measures in children with asthma (*n* = 15)

	Baseline	Four weeks	Median change	<i>p</i> value
FEV ₁ (% predicted)	72.0 (60.5–81.5) (2)	85.0 (73.5–93.3) (5)	11 (–4.5–24.8)	NS
FEF _{25–75} (% predicted)	56.0 (45.0–67.5) (2)	71.0 (56.5–77.8) (5)	6.5 (–4.8–24.8)	NS
PEFR (% predicted)	81.3 (62.3–95.8) (3)	87.8 (70.5–101.9)	8 (3–13)	< 0.05
PEFR variability (%)	12.5 (7.0 and 22.7) (4)	7.8 (5.7–9.1) (5)	–4.0 (–11.1–1.2)	< 0.05

Results are expressed as median (interquartile range) (any missing values).

FEV₁, forced expiratory volume in one minute; FEF_{25–75}, forced expiratory flow from 25% to 75% of lung volume; PEFR, peak expiratory flow rate; PEFR variability, variations of PEFR between morning and evening.

of cognitive tasks and completed the children's depression inventory while the mother completed the sleep questionnaire, the sleepiness scale, and the behaviour questionnaire.

The control children completed exactly the same battery of cognitive tests and completed the children's depression inventory, and their mothers filled in the sleep, sleepiness, and behaviour questionnaires.

Phase 2

Once the baseline information had been collected, 15 children with asthma returned to the respiratory clinic to have their treatment changed, with a particular emphasis on improving nocturnal symptoms. The treatment was tailored to the individual child. Four children had their inhaled steroid dose increased, while one child had theophylline and 10 children had salmeterol xinafoate added to their treatment regimens.

The children with asthma were revisited four weeks after the treatment change to assess alterations in their nocturnal asthma symptoms, sleep, cognitive function, mood, and behaviour. Assessments were performed in exactly the same manner as at baseline.

At the end of the study period, children returned to their clinic for reassessment.

Table 4 Home polysomnographic findings and parental ratings of child's sleep quality impairment and daytime sleepiness in children with asthma (*n* = 15)

	Baseline	Four weeks	Median change	<i>p</i> value
Polysomnography				
Actual sleep time (minutes)	527.5 (485–574.5)	507.5 (451–590.5)	–17.3 (–56.6–36.8)	NS
Sleep efficiency (%)	93.8 (87.8–97.0)	96.8 (96.8–98.1)	3.2 (–0.3–6)	NS
Sleep latency (minutes)	16.5 (11.8–19.6)	17.5 (12.3–27.1)	5 (–6.1–15.6)	NS
Number of awakenings < 2 minutes	13 (9–17)	2 (0–4)	–10.5 (–13.8 to –5)	< 0.05
Number of awakenings > 2 minutes	5 (2–8)	0 (0–2)	–4.5 (–7 to –2.3)	< 0.05
NREM stage 1 (%)	7.3 (5–8.8)	6.3 (3.8–9.3)	2.2 (–4.2–4.4)	NS
NREM stage 2 (%)	25.4 (20.8–36)	20.1 (11.7–32.2)	–4.1 (–9.2–7)	NS
NREM stage 3 and 4 combined (slow wave sleep) (%)	34 (29.4–38)	43.3 (31.4–55.7)	7.4 (–1.9–11)	NS
REM latency (minutes)	100.5 (86.8–142.4)	107.3 (80.4–158.8)	–0.8 (–10.5–13.1)	NS
REM sleep (%)	20.2 (16–27)	20.6 (17–26.2)	–0.2 (–3.5–4.9)	NS
Parental ratings				
Impairment of sleep quality (%)	25 (8–46)	25 (10.25–39.8)	–6 (–17–8)	NS
Daytime sleepiness (%)	19 (10–31) (2)	26.5 (10.6–33)	0 (–5–4.9)	NS

Results expressed as median (interquartile range) (any missing values).

NREM, non-rapid eye movement

STATISTICAL ANALYSIS

Analyses were planned to compare the children with asthma at baseline with the control group (phase 1) and to assess differences within the group with asthma from baseline to four weeks post-treatment change (phase 2). Data screening methods were used to check the data for errors and to determine its nature and the most appropriate statistical tests.

In the group with asthma, differences between results at baseline and the four week assessment were calculated for each of the variables. The distribution of these differences, and the distribution of variables in the control group, were tested for normality using the Kolmogorov-Smirnov test. The findings indicated that non-parametric methods were the most appropriate forms of analysis. Wilcoxon matched pairs tests and Mann-Whitney tests were used as appropriate. A probability value of 0.05 was used to judge minimum significance.

Results

There were a small number of missing data points, accounting for the slightly reduced number of observations on some of the statistical tests, as indicated in the tables.

PHASE 1: COMPARISONS BETWEEN CHILDREN WITH ASTHMA AND CONTROLS

Polysomnography

Although actual sleep time and conventional NREM and REM stages were not significantly different in the two groups, the sleep of the children with asthma showed very much higher rates of disruption by both brief and longer awakenings, producing a much reduced sleep efficiency (table 1).

Subjective impairment of child's sleep quality and daytime sleepiness

The impairment level of the children with asthma, as reported by parents on the sleep questionnaire, was very much higher than controls (table 1). In addition, daytime sleepiness was reported to be significantly higher in the asthmatic children.

Cognitive function

The children with asthma performed significantly worse than control subjects on the memory task of delayed recall. The median number of correct scores for the group with asthma was 8.0 (interquartile range, 4.3–15.5) and that of the control group was 16.5 (interquartile range, 7.0–20.6). This difference was significant at the *p* < 0.05 level. No significant differences were found on the other cognitive tests, although there was a trend towards poorer performance on the tests of immediate recall and sustained attention (data not shown).

Mood and daytime behaviour

The group with asthma reported themselves as significantly more depressed than the controls and were rated by their parents as significantly worse for learning problems and psychosomatic symptoms (table 2). There was also an indication of greater problems with conduct.

Table 5 Mood and behaviour ratings of children with asthma (*n* = 15)

	Baseline	Four weeks	Median change	<i>p</i> value
Children's depression inventory	8 (4.5–13.5) (2)	8.0 (4.0–4.1) (1)	–3 (–6.5–0)	< 0.05
Conners' scale				
Anxiety	1 (0.5–1.3)	0.5 (0.3–1.0)	–0.3 (–0.3 to –0.1)	NS
Conduct problem	0.5 (0.3–1.5)	0.5 (0.1–1.3)	–0.2 (–0.4–0.1)	NS
Hyperactivity/impulsivity	1.3 (0.5–2.3)	0.5 (0.3–1.8)	–0.1 (–0.7 & 0.2)	NS
Learning problems	1.0 (0.3–1.8)	0.8 (0.0–1.5)	–0.4 (–0.7–0)	< 0.05
Psychosomatic symptoms	0.8 (0.3–1)	0.5 (0.0–1.0)	–0.1 (–0.5–0.2)	NS

Results expressed as median (interquartile range) (any missing values).

PHASE 2: CHANGES IN CHILDREN WITH ASTHMA FOLLOWING ADJUSTMENT OF TREATMENT

Asthma severity

At baseline, children reported waking from between one or two nights a week to seven nights a week, with a mean of 4.3 nights a week. After treatment change, only three children still reported waking at night. Initially, 13 of 19 children who were questioned reported exercise limitation; this was reduced to one after treatment. Five children reported school disruption because of their asthma and this also decreased to one after treatment.

FEV₁ and FEF_{25–75} measured during clinic visits both improved, although not significantly (table 3). Mean PEF, from home recordings, had significantly improved four weeks after treatment change, by which time diurnal variation in PEF had also decreased significantly.

Polysomnography

The number of awakenings (both of short and long duration) had decreased significantly at four weeks after treatment, to the point of being very similar to the rate seen in the normal control group (table 4). Other sleep variables showed no significant change.

Subjective impairment of child's sleep quality and daytime sleepiness

At the four week assessment, almost two thirds of the mothers reported that they thought their child's sleep had improved (table 4). Maternal responses to the sleep questionnaire also indicated that sleep quality had improved slightly by that time, although this was not significantly different. Reports of daytime sleepiness had not improved.

Cognitive function

The asthmatic group's performance on two tests improved significantly by the four week assessment: the median score obtained for the delayed recall memory task had improved from 10.5 (interquartile range, 5.5–19) to 16.3 (interquartile range, 10–22.8). The median change score was 3.9 (interquartile range, 0.4–5.5). The median time to complete the letter matching task, a measure of both memory and attention, had improved from 137 seconds (interquartile range, 74.0–230.5) to 107 seconds (interquartile range, 55–175). The median change score for this test was –22 (interquartile range, –30 to –15). Both of these differences were significant at the *p* < 0.05

level. No significant differences were found for any of the other cognitive tests (data not shown).

Mood and daytime behaviour

After four weeks, the children's mood had improved significantly and their scores were significantly lower on the parent factor of learning problems (table 5).

Discussion

SLEEP PATTERNS OF CHILDREN WITH NOCTURNAL ASTHMA

Carroll and Loughlin²³ have discussed the possible reasons why children often have a worsening of their asthma symptoms at night. Whatever the causes, this seems to be a common occurrence and, from the present results, is often associated with disruption of sleep.

In this study, parental reports provide further evidence of impairment of the sleep quality of children with asthma, with associated daytime sleepiness. However, it is possible that such subjective reporting underestimates the size of the problem, judging from the finding in the preliminary phase of the present study that such reporting fails to distinguish reliably between children with asthma who sleep badly and those who sleep well.

Objective sleep studies indicated that the main sleep abnormality associated with asthma symptoms at night is interruption of the continuity of sleep by frequent awakenings. These awakenings vary in duration and include many that are so relatively brief that their occurrence would be overlooked without careful monitoring. Increasingly, this fragmentation of sleep is being viewed (from both experimental studies and observations in a range of clinical conditions) as having more serious effects on daytime functioning than changes in conventional sleep stages,²⁴ which were largely unaffected in the present sample of children with asthma.

As mentioned previously, an earlier polysomnographic study⁸ reported a reduction in SWS in children with asthma, generally in keeping with comparable studies in adult patients, but at variance with the present findings. However, a number of uncertainties has been raised about this study, including the possible effect on sleep of stopping medication six hours before the start of the study in most patients.²³ Moreover, there are indications that adults and children differ from each other regarding the effect of persistent sleep disturbance on SWS. Little or no effect on this stage of sleep has been reported for children with obstructive sleep apnoea²³ and other clinical groups of children, including those with severe nocturnal eczema.^{24a} This finding is a further illustration of the differences that apparently exist (and need to be noted) between child and adult sleep disorders medicine.²⁵ Comparison between the baseline physiological findings in the present study and those of Avital and colleagues,⁹ who reported normal sleep physiology in adolescents with asthma, is complicated by the fact that their patients were well

controlled with medication. The more appropriate comparison is with the present findings following treatment, when the results appear very similar.

For the present study (and others involving children), home polysomnography was considered to offer a much more acceptable form of physiological sleep study than admission to a sleep laboratory (few of which exist). It has been suggested that, because of the relatively non-standardised nature of home recordings and extraneous influences on sleep time compared with laboratory studies, it should be assumed that sleep at home will be less consolidated. However, apparently this is not the case, according to recently compiled home polysomnography norms for children (Stores *et al*, unpublished data, 1998), and the consistently demonstrated absence of significant first night effects in children's home recordings,^{26 27} in contrast with those obtained in the unfamiliar laboratory setting. In any event, it is clinically important to know about sleep patterns of children in their own beds rather than in an unnatural overnight environment.

PSYCHOLOGICAL PROBLEMS OF THE CHILDREN WITH ASTHMA

The children with asthma showed only marginal evidence of disturbed cognitive function compared with their controls, the tendency being towards impairment of memory and attention. This impairment is in keeping with other reports about the effects on children of disturbed sleep and the effects of daytime sleepiness on performance.^{10A} In general, it is also in keeping with information from other sources about the cognitive difficulties of children and adults with asthma.^{4 7}

However, further refinements are needed for future research on this topic. The impression gained was that most of the present group of children, especially the older ones, found the cognitive tasks relatively undemanding because the level of difficulty had been set to allow for the wide age range. This simplicity might have reduced the sensitivity of the tasks for detecting the effects of sleep disturbance. Motivation is also likely to be a relevant issue when children are tested for the first time. Although encouragement was kept to a minimum in this study, it is conceivable that the children wished to do well and made an effort to overcome their sleepiness.

The extent of cognitive impairment could also have been underestimated in the present study because of extraneous influences in the home environment. Home testing was favoured because of the convenience to subjects and parents, and to ensure that children were more relaxed than they might be in a laboratory setting. Testing at home was also expected to produce more representative results of the child's daily functioning. In the event, testing circumstances varied widely, such that influences additional to those under investigation might have affected the outcome of the assessments. These considerations bear witness to the robust nature of the cognitive differences that *were* found between the children with

Key messages

- Sleep disturbance is common in children with asthma, more than is usually supposed.
- The nature and extent of sleep disruption is only partly apparent from subjective, clinical reporting; physiological sleep recordings might be more informative, showing fragmentation of sleep by brief arousals rather than changes in conventional sleep stages.
- Disruption of sleep in these ways might affect the child's daytime cognitive function, mood, and behaviour.
- Identification and control of nocturnal asthmatic symptoms is important, not only to improve respiratory function but also to promote better quality sleep and psychological well being during the day.

asthma and controls. Longer and more complex tests, performed in a consistent environment, might have demonstrated further cognitive deficits in the children with asthma.

The children with asthma scored higher than controls for a number of aspects of mood and behaviour as rated by themselves or their parents. Because children differ in the way that they manifest distress, a complicated picture of psychological upset can be expected in any one group. It seems reasonable to conclude that, based on no more than screening methods, these findings are compatible with other evidence that children with asthma are predisposed to psychological difficulties for a variety of reasons. Clearly, careful inquiry is needed to assess the exact type and severity of the problem in the individual case.

CHANGES FOLLOWING TREATMENT OF NOCTURNAL ASTHMA SYMPTOMS

In general, the change of anti-asthma treatment for the nocturnal symptoms was associated with some improvements in measures of respiration, sleep, and psychological function. Parental reports indicated clinical improvement in their child's asthma and measures of respiratory function were better. Similarly, both subjective and objective findings indicated that sleep had improved. Although parental reports on this aspect showed some inconsistencies (and indeed reports of daytime sleepiness showed no change), sleep studies showed a marked improvement in awakenings. Some aspects of cognitive function, mood, and behaviour also appeared to have recovered, compared with pretreatment levels.

On the basis of these findings, it is tempting to attribute direct and simple causal connections between nocturnal asthma, sleep, and daytime psychological function, but this would be to pre-empt the further research needed to clarify the nature of the relations involved, to identify mediating factors, and to explain the inconsistencies in present reports.

For example, the effects of anti-asthma medication remain a contentious issue. The

relative sleep consolidating and sleep disruptive properties of different anti-asthma preparations have been studied very little. As Carroll and Loughlin state: "more data are needed to define the sleep patterns of children with asthma both on and off therapy."²⁸ In addition, concerns have been expressed that anti-asthma medication might have a detrimental influence on cognitive performance and mood. Theophylline has been implicated, but with inconsistent findings in different studies, although some children seem to be susceptible.²⁹ Bender and colleagues³⁰ reported that, when taking a high dose of oral prednisone, children with asthma had more difficulty on a task of long term memory retrieval and lower mood than when they were treated with a smaller dose. Neither of these treatments featured prominently in the present study and, where they were used to improve control of nocturnal symptoms, there was an associated improvement in psychological function.

Although this was an exploratory study, there are strong indications in the findings (and those from other studies) that sleep disturbance in children with asthma deserves more attention than it is given traditionally. Apart from the many research issues involved, it seems likely that attempts to prevent or treat sleep abnormalities would benefit affected children not only by providing more satisfying sleep, but by reducing at least one of the factors that can contribute to the psychological and other developmental disadvantages to which, as a group, they are prone.³¹

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Appendix

The following cognitive tests were used:

Visuomotor coordination: the time to complete a spiral maze taking account of errors.

Memory: two stories were read to the subject. Immediate and delayed recall were assessed by asking the child to repeat the stories immediately and again at the end of the test session. Responses were scored for factual content.

Memory/attention: digit span, both forwards and backwards, was assessed by asking the child to repeat progressively longer, verbally presented digit lists.

A "letter matching task" was also used that required the child to read through a page of unpronounceable letter strings and, as quickly as possible, to match up the ones that were identical. The score was the time to complete the task, taking account of errors.

Attention: "focal attention ability" was assessed by a simple card sorting task. The child was instructed to deal cards into two piles as quickly as possible, on the basis of the presence/absence of a particular characteristic. The score was the time to complete the task, taking account of errors, with longer times indicating problems in focusing attention.

As a measure of sustained attention, the child listened to a 16 minute tape of numbers. In every 30 second section, one number was replaced randomly by a letter and the child was required to make a note of these letters. The score was the number of letters identified correctly.

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