Differential Influences on Asthma Self-management Knowledge and Self-management Behavior in Acute Severe Asthma*

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Aim: While asthma education increases knowledge, it is less clear whether education influences actual patient behavior. To determine whether there are differences between asthma self-management knowledge and the actual behavior of patients during an acute severe asthma attack and to determine which clinical and psychosocial factors are associated with knowledge and behavior.

Methods: Validated hypothetical scenarios describing the development of life-threatening asthma and patients’ reported actual behavior were scored (out of 25) using a system based on Thoracic Society of Australia and New Zealand and British Thoracic Society criteria.

Results: In 137 patients admitted to the hospital with severe asthma, the pattern of the index attack was slow onset (≥6 h) in 96%. The score for the hypothetical attack (knowledge) was 13.8±4.6, while that for the timeline (behavior) was 10.2±3.9 (p<0.001) with 56% and 84%, respectively, having a score of less than 15 (regarded as inadequate). Certain components showed marked discrepancy (eg, appropriately seeking medical help 82% vs 52% (p<0.001) and calling ambulance 61% vs 23% (p<0.001). Factors such as physician-patient relationship, previous asthma morbidity, availability of peak flow meter, action plan, and oral steroids correlated positively with both measures. Knowledge was negatively associated with being non-European, with anxiety, pessimism, and stigmatization. Behavior (but not knowledge) was negatively associated with lack of knowledge of what to do in the index attack, previous emotional counseling, and business failure. Those factors associated with the difference between knowledge and behavior scores (knowledge-behavior gap) were being non-European, anxiety, pessimism, and stigmatization, concerns about medical costs, and the only income for the household being a Social Security benefit.

Conclusion: There are marked differences between patients’ self-management knowledge and their actual behavior, particularly in terms of potentially life-saving actions. Psychological, health-care, and socioeconomic factors have a powerful and differential influence on knowledge and behavior. Improved understanding of the discrepancies between knowledge and behavior and which factors influence them may lead to more effective asthma educational interventions.

(CHEST 1996; 110:1463-68)

Key words: acute asthma; asthma education; behavior; knowledge self-management

Abbreviations: PEF=peak expiratory flow

Although international consensus guidelines on asthma management have stressed the importance of patient education, the relationship among educational interventions, self-management knowledge and skills, illness behavior (particularly during an acute attack), and changes in morbidity (and mortality) remain unclear and controversial. Following a meta-analysis of 11 randomized clinical trials of self-management teaching programs, Bernard-Bonnin et al concluded that educational programs improve knowledge but do not reduce morbidity and that the relationship between self-management teaching and morbidity is confounded by multiple factors that are not directly amenable to change by education. Therefore, they suggested that future programs should focus more on intermediate outcomes such as behavior. In the largest intervention study of asthma education reported thus far, Garrett et al showed that the group randomized to receive intensive asthma education at a community-based center had better knowledge subsequently of the appropriate action to take when confronted with...
worsening asthma than those randomized to usual follow-up. Nevertheless, there was little change in any of the indexes of illness behavior or in conventional measures of asthma morbidity when the intervention group was compared with the control group.

These findings have important implications that must be confronted and further examined. Knowledge is important only to the extent that it may have a beneficial influence on illness-related behavior and hence morbidity. To put it another way, the primary aim is to improve the outcome of patients not necessarily to create a better-educated population. Thus, there is a need to study more closely not only the extent to which practical asthma knowledge can be acquired, but also the extent to which this knowledge impacts on actual behavior. In particular, we need to know which factors augment or detract from these linked outcomes.

This study was designed to test the hypothesis that in patients with moderate to severe asthma, improvement in outcome and reduction of morbidity involve the acquisition of knowledge, the implementation of self-management behavior, and that this sequence of events will be differentially influenced by socioeconomic, psychological, and health-care factors. These factors and their interrelationships were examined in detail as they affected the course of an evolving acute attack of asthma.

**Materials and Methods**

**Study Design and Patients**

A cross-sectional study was undertaken of patients (aged 15 to 49 years), normally resident in the Auckland region, with acute severe asthma, admitted to the only 4 major hospitals in the region. Patients aged 50 years or older were excluded to avoid the major inaccuracies in the diagnosis of asthma in older patients. The lower age limit is the age at which patients are transferred to adult clinics and are considered to be of sufficient maturity to assume responsibility for their own health. Patients were either admitted directly to the ICU with severe life-threatening asthma or to the general medical wards. Patients were excluded if the primary reason for the hospital admission was not acute asthma or the patient was admitted primarily for an asthma complication, e.g., pneumothorax, pneumomediastinum, or because of the presence of other serious or life-threatening illnesses. All patients satisfied the criteria for reversible airflow obstruction (ie, bronchodilator response of more than 20% improvement in peak expiratory flow (PEF) or FEV1.

A detailed questionnaire was administered to all patients within 24 to 72 h of admission to the general medical ward (either directly or after discharge from the ICU) by a single research associate (W.F.). All components were interviewer administered and included the following: (1) patient demographics; (2) quality of previous medical care and usual asthma management, including acquisition of PEF meters, action plans, availability of oral steroids, measurement of PEF, checking of metered-dose inhaler technique, and accessibility of the family physician; (3) details of the patient’s socioeconomic status with particular reference to aspects that may influence asthma management, including unemployment, financial dependence on social security benefits, financial difficulties in the last year, and inability to afford physician visits or prescription costs; (4) asthma morbidity, in terms of number of ICU admissions (ever and last 12 months), hospital admissions (ever and last 12 months), emergency department visits (last 12 months), courses of oral corticosteroids (last 12 months), and the need for continuous oral steroid therapy (>7.5 mg prednisone per day for ≥1 month) (in the last 12 months); (5) assessment of the practical knowledge of self-management of acute asthma, by the use of scenarios describing two hypothetical attacks: one described an attack of increasing severity over 7 days (slow onset) while the second described an attack that developed over 1 h (rapid onset); both scenarios ended with the subject “experiencing” a severe attack such that he/she was so wheezy and short of breath as to be unable to speak or rise from a chair; at three stages during each of the scenarios, subjects were asked to describe what action they would normally undertake if they were actually experiencing such symptoms; the scoring system, in which scores were weighted for strategies considered most important in aborting an attack or to be potentially lifesaving, was based on Thoracic Society of Australia and New Zealand and British Thoracic Society7,8 consensus statements on the management of asthma; and (6) patient behavior, assessed by a very detailed history of symptoms and self-management strategies undertaken prior to hospitalization; particular attention was paid to symptoms that defined “stages” in the hypothetical scenarios and the self-management strategies undertaken in relation to those stages in the actual attack; the index attack was then classified as rapid (<6 h) or slow (≥6 h); The subjects’ “behavior” during the index attack could then be scored using the same system as for the scenarios. Total possible score for the measures described in 5 and 6 is 25; a score of less than 15 is considered to represent a clinically significant inadequate self-management knowledge/behavior score. (7) Level of anxiety and depression used the Hospital Anxiety and Depression scale9 (which is specific for distress in physically ill subjects) and state and trait anxiety assessed on a visual analog scale; denial of anxiety was defined by a high score on the Hospital Anxiety and Depression scale in association with a patient perception of low anxiety on the (state-) trait assessment, ie, as unawareness of anxiety in the presence of responses strongly suggestive of it; (8) social support, measured by a modification of the scale of O’Reilly and Thomas10 that was designed to evaluate social support in patients with cardiac disease; this included an assessment of general support as well as disease-specific support, both day to day and during acute attacks; and (9) life events, using a validated modification for New Zealand of the life event scale of Tenant and Andrews,11 The instruments used in 5, 6, and 7 have previously been trialed and found to be feasible, acceptable, and reliable in patients attending an asthma clinic7 and in different ethnic groups.11 (10) Attitudes and beliefs about asthma used a modification of the instrument developed by Sibbald et al,13 this questionnaire has also been extensively modified, consensual validity tested, and trialed in a patient group.15

**Ethics**

All subjects gave written informed consent to participate in the study, approved by the Auckland Healthcare Ethics Committee.

**Statistical Analysis**

Data are expressed as mean±SD. Differences between scores were determined by paired t test. Knowledge score, behavior score, and knowledge-behavior gap were treated as dependent variables and univariate analyses were used to determine those independent variables (socioeconomic, health-care, and psychological factors) that significantly predicted the respective scores. General linear modeling was used to investigate multivariate relationships. Factors that were significant at p<0.05 level were entered into the multivariate analysis to ensure that the model overall was significant and to determine those variables that remained unique predictors of a significant amount of variance in the dependent variables even
when all of the variance predicted by the other variables had been removed previously. Predictor variables from the multivariate analysis were then entered into a forward stepwise analysis. A p value <0.05 was regarded as statistically significant.

Results

One hundred thirty-seven subjects aged between 15 and 49 years (30.3±10.7 years) were recruited. Three satisfied the criteria for inclusion, but were not recruited: one refused to participate; one was excluded because of inadequate English-language skills, and one was excluded for other reasons (severe mental retardation). Of the 137 subjects, 75% were female and 62% European, 18% Maori, 18% Pacific Island, and 1% other; this ethnic distribution is not significantly different from that of the Auckland population in this age group. English was the primary spoken language for 94%.

Generally patients had acute severe asthma at the time of hospital admission and substantial long-term morbidity. Arterial blood gas data were available from the time of presentation in 90 subjects; pH=7.3±0.2; PaCO₂=7.1±5.0 kPa (mean±SD). Despite severe asthma on presentation, the duration of hospital stay was short (3.7±2.6 days), with only 3.5% staying longer than 7 days. Thirty-five percent had a previous ICU admission for severe life-threatening asthma (7% in the last year), and 73% had a previous hospital admission (36% in the last year). Patients had substantial chronic asthma symptoms; 59% indicated moderate or severe interference with exercise over the last year and 58% described moderate or severe interference with sleep over the same period. Sixty-three percent stated they used regular inhaled steroids; 34% using less than 1,000 µg/d, 23% using 1,000 to 2,000 µg, and 17% using more than 2,000 µg/d of beclomethasone dipropionate or equivalent in the 2 weeks prior to hospital admission.

Knowledge and Behavior

In 131 subjects (95%), the index attack was classified as being of “slow onset.” Because the number of patients experiencing a “rapid onset” (<6 h) index attack was small (n=7), they were excluded from further analyses. The score based on knowledge (the scenario score) was greater than that for behavior during the index attack (13.8±4.6 vs 10.2±3.9, respectively; p<0.001). Fifty-six percent of the group obtained a score of less than 15, ie, demonstrated an inadequate level of self-management⁶ for the scenarios, while 54% obtained a score of less than 15 for the index attack (p<0.001). In individual patients, the scenario score (“knowledge”) almost always exceeded the score for the index attack (“behavior”) (Fig 1), although the 2 values were highly statistically significantly related (p<0.0001). As well as the differences in total scores, there were marked differences in some management strategies between the hypothetical scenarios (knowledge) and the reported behavior during the index attack (Table 1).

Socioeconomic, psychological, and health-care factors were analyzed to determine their effect on the knowledge score, the behavior score during the index attack, and the difference between the scores (knowledge-behavior gap).

Knowledge score was positively associated with medical care factors such as availability of PEF meter (p<0.0002), written action plan (p<0.001), readily available supply of oral corticosteroids (p<0.001), previous use in the last year of oral corticosteroids (p<0.01), physician-patient relationship (factor 2 of Attitudes and Belief Questionnaire¹³) (p<0.001), and the level of formal education (p<0.002). Knowledge was negatively associated with ethnicity (Maori and Pacific Island) (p<0.005), disease-related stigma and pessimism (factor 3 of Attitudes and Belief Questionnaire) (p<0.01), and level of anxiety (both state and trait) (p<0.015). Concerns about medical costs (p<0.07) and self-professed lack of knowledge during the index attack (p<0.054) were also associated but did not reach statistical significance.

Behavior score was positively associated with medical care factors such as availability of PEF meter (p<0.002), written action plan (p<0.001), readily available supply of oral corticosteroids (p<0.001), use of oral corticosteroids in the last year (p<0.01), hospitalization (emergency department and admissions) in the last year (p<0.001), and physician-patient relationship (factor 2 of Attitudes and Belief Questionnaire) (p<0.05). Behavior score was negatively associated with self-professed lack of knowledge during the index attack (p<0.05), previous emotional counseling (p<0.0042), and recent business failure (from life events scale) (p<0.05). Concerns about medical costs during the index attack (p<0.09), having looked for work for greater than 1 month in the last year (p<0.10), panic during the index attack (p<0.06), and denial of anxiety (p<0.055) were also negatively associated with the behavior score but did not reach statistical significance.

The difference between the two scores (knowledge-
behavior gap) was positively associated with the following: being non-European (p<0.05), disease-related stigma (as measured by factor 3 of Attitudes and Belief Questionnaire) (p<0.001), current self-rated anxiety (state) (p<0.02), concerns about medical care costs during the index attack (p<0.015), and the only income for the household being a Social Security benefit (p<0.04). Although the total number of life events in the past year was not significant, recent loss of a partner (p<0.06) and having property lost or stolen (p<0.067) were of borderline significance. Higher education was negatively associated with the difference (p<0.020), ie, better education made it more likely that theoretical knowledge would be reflected in reported behavior.

These associations are shown in Figure 2. To further examine these associations, a general linear modeling analysis was undertaken to examine the knowledge-behavior gap, combining all of the above factors. This model predicted the size of the discrepancy significantly (F=3.96, p=0.0004) and the model accounted for 21% of the variance.

**DISCUSSION**

This study demonstrates that while the acquisition of practical asthma knowledge is an important part of asthma management, it is not in itself sufficient for satisfactory asthma self-management behavior. There was encouraging evidence that those features which one would associate with appropriate educational initiatives and good quality of ongoing medical care (viz, possession of a PEF meter, a written action plan, and a supply of oral corticosteroids) were positively associated with the scenario score (“knowledge”) and with the index attack score (“behavior”). These results provide support for the asthma educational interventions being undertaken in a number of countries, including New Zealand.1

In addition, previous experience seemed to improve knowledge and behavior as shown by the positive association between previous hospitalization and higher scores. This is opposite to what one might intuitively predict based on the presumption that a reduction in morbidity results from improved knowledge and self-management behavior.2 However, frequent hospital presentation provides increased opportunity for educational intervention at a time when the patient is particularly receptive. Behavior responds to the cumulative learning experience of the patient, including those experiences incidental to or preceding their participation in planned educational programs.14 Possibly those patients who benefit most from asthma education are those who have the opportunity of putting their new skills into practice and learning from any
mistakes. As such, skills may be gained progressively over time. Put most simply, experience may be the best teacher.

Another important feature of asthma education is the provision of empathetic communication. In this study, physician-patient relationship (a factor derived from the Attitudes and Beliefs Questionnaire and made up of statements such as “I have confidence in my doctor’s management of my asthma”, “I wish my doctor talked more to me about my asthma” [negative], “I feel understood by my doctor”, “My doctor tells me everything I want to know about my asthma”) was associated positively with both knowledge and behavior scores. Although the quality of ongoing medical care could not be formally assessed in a study of this type, a number of indicators suggested that this was generally good. More than 95% of patients were able to nominate a family physician and of the 77 who had tried to obtain an urgent appointment in the last year, 99% had experienced no difficulties. Forty-eight percent had their inhaler technique checked in the last year and 80% had their PEF measured or their PEF diary reviewed on most visits (unpublished data). This reinforces the need for good quality stable ongoing medical care by a skilled and empathetic physician as being central to the overall management of asthma.

Factors that were negatively associated with knowledge, namely being non-European, a sense of stigmatization related to asthma, and high levels of anxiety, can all be readily understood as interfering with the ability to absorb the essential components of an educational program. Such programs are run by predominantly European health-care professionals and require an acceptance of the diagnosis of asthma in a personal sense, a health-care belief model similar to that of the educators, and a sufficient state of calm to take in information. Efforts to make the environment in which the educational messages are imparted more relaxed, informal, and culturally appropriate, as in the study by Garrett et al, may go some way to overcoming these problems.

Further, there were marked and worrying differences between practical self-management knowledge and stated behavior during the acute attack. In virtually all cases, the knowledge score exceeded that for the actions reportedly taken. In other words, even when patients had a reasonable idea of what to do in an acute attack (and it must be remembered that only 44% of this sample were judged to have a satisfactory level of knowledge in terms of their scenario performance), they much less frequently put these strategies into practice when faced with the real-life situation. Thus, to rely merely on assessment of knowledge as the measure of the effectiveness of an educational strategy may critically overestimate the impact of that intervention and its likely influence on morbidity and mortality.

As well as the marked discrepancy between total scores, there were worrying differences in some individual self-management behaviors (Table 1). Of concern, those strategies that showed the greatest disparity between the hypothetical scenarios and reported behavior during the index attack are precisely those that are most likely to abort successfully an impending attack or to be potentially lifesaving. Furthermore, it is possible that actual rather than reported behavior is even more hazardous. For many reasons, including the perception that hospital admission is a failure of self-management, patients may present the sequence of events more favorably than occurred in reality.

Factors influencing the difference between knowledge and reported behavior were being non-European, feeling stigmatized by the disease, and having a high level of anxiety, but in addition, concern about the cost of medical care during the index attack, having only a Social Security benefit as the only income in the household, low educational level, and recent loss of a partner. Combined together, these factors predicted 21% of the variance of this knowledge-behavior gap. This highlights one possible mechanism of operation of socioeconomic disadvantage and unemployment, well known to be associated with respiratory disease, including severe asthma. Mechanisms such as greater exposure to etiologic or aggravating factors, inadequate health care because of poor quality or reduced accessibility, and disadvantage secondary to direct and indirect effects of the illness have all been previously postulated. However, the adverse effects of socioeconomic disadvantage may be more subtle and insidious. In this study, it was shown that they impaired the ability to put into practice what had been learned previously. This throws further light on the findings of Rubin and Bauman. In a study of children with moderately severe asthma, they showed that asthma management behavior was significantly related only to knowledge about asthma and patients of higher socioeconomic status were more likely to comply with recommended procedures. In other words, basic knowledge is necessary, but not sufficient, and the relationship among knowledge, attitudes, and behavior differs between patients from different backgrounds.

Conventional indicators of socioeconomic disadvantage such as the Elley-Irving scale were not used in this study because they do not reliably indicate socioeconomic disadvantage between different ethnic groups. Ethnicity (Maori and Pacific Island vs European) was also negatively associated with scenario scores and positively associated with the difference between the two scores. This may reflect increased economic hardship among Maori and Pacific Islanders.
relative to Europeans, but may also reflect barriers to health care\textsuperscript{24,25} and different health belief models (not specifically measured in this study).

This study also showed the importance of psychological factors. The behavior score was negatively affected by the occurrence of panic during the attack, by awareness of anxiety (which may in itself explain its worsening to panic level), and also to having had previous emotional counseling. The discrepancy between knowledge and behavior was positively associated with the current level of anxiety. Patients with severe or brittle asthma do have high levels of psychological morbidity.\textsuperscript{26} This study provides insight into self-management behavior as one of the many mechanisms by which psychological factors may influence asthma morbidity and mortality.

There is obviously a need to acknowledge that severe social, economic, and psychological factors may so totally dominate and overwhelm the individual as to nullify the potentially positive influences of asthma education. This is consistent with the hierarchical principle of behavioral change in education in which there is a natural order in the sequence of factors influencing behavior.\textsuperscript{14} Attempts to address certain issues before addressing others higher in the hierarchy are unlikely to be particularly successful. Thus, an attempt to teach self-management skills without addressing whether there are feelings of stigma relating to asthma, high levels of anxiety, and the most pressing financial and practical concerns facing patients is likely to substantially compromise results.

The detailed accounts of the index attack on which much of this study is based are entirely subjective and may represent significant distortion of the events that actually took place. It is our contention, however, that the patient’s version of events does represent a vital “truth” that must be addressed in ongoing clinical interventions. The other major limitation of this study is that the complexity of the interrelationships makes it difficult to determine the direction of effect. In other words, it remains possible that all the psychological and socioeconomic factors that we have highlighted are merely epiphenomena of having very severe asthma. However, the scale of psychosocial and socioeconomic disadvantage demonstrated in this sample at the very least implies the need to tailor interventions, particularly educational initiatives.

While only an intervention study will provide definitive answers, this study highlights yet again the importance of an improved understanding of the powerful and differential influences of psychological, socioeconomic, and health-care factors on self-management knowledge and behavior and the potential influence of this on asthma educational activities.

ACKNOWLEDGMENTS: The authors thank Margaret McKinlay for her assistance in the preparation of the manuscript.

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