Asthma mortality: comparison between New Zealand and England

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Abstract

Causes for the high mortality from asthma in New Zealand were investigated by comparing deaths from asthma in caucasian subjects aged 15-64 in New Zealand with those from asthma in the same age group in two regions in England. There were no significant differences in the accuracy of death certification. The verified asthma mortality in New Zealand (4.2/100 000) was over twice that in England. Many characteristics of patients and management, including poor compliance with treatment and deficiencies in long term and emergency care, were qualitatively similar in the two countries. New Zealand had an apparently higher rate of non-preventable deaths from asthma, suggesting a greater severity of asthma in New Zealand. In both countries, however, most deaths were associated with poor assessment, underestimation of severity and inappropriate treatment (over-reliance on bronchodilators and underuse of systemic corticosteroids), and delays in obtaining help. A greater frequency of some of these deficiencies in management remains a possible additional explanation for part of the excess mortality in New Zealand.

Introduction

There is now no doubt that New Zealand experienced an increase in asthma mortality in the late 1970s, especially in the 5-34 year age group, whose mortality from asthma rose abruptly from 1977.¹ Hospital admission rates for asthma increased,² and while sales of antiasthma drugs also increased in the United Kingdom and Australia between 1975 and 1981, sales per head were highest in New Zealand.³ There was concern that changing patterns of drug treatment, particularly the combination of oral theophylline with β sympathomimetic drugs⁴ and the use of home nebulisers for administration of high doses of β sympathomimetics,⁵ might have influenced mortality. Alternatively, other aspects of management or characteristics of asthma in New Zealand may have changed.

In 1979 the British Thoracic Association surveyed asthma mortality in 15-64 year olds in two regions of England.⁶ From

August 1981 to July 1983 a two year nationwide study of asthma mortality was conducted in New Zealand.⁷ While New Zealand and the United Kingdom are not fully comparable in climate, population, ethnic mix, or organisation of health services, underlying similarities in the caucasian populations justify comparison of mortality from asthma between the two countries. It was hoped that such a comparison might suggest possible reasons for the much higher reported asthma mortality in New Zealand.

Methods

The Asthma Task Force of the Medical Research Council of New Zealand undertook a two year national review of all deaths in people usually resident in New Zealand who died between 1 August 1981 and 31 July 1983 and for whom part I of the death certificate or the coroner's report contained the word "asthma," "asthmatic," or "asthmaticus."⁷ Cases were identified by reviews of death certificates at local offices of registrars of births, deaths, and marriages and at the National Registry of Births, Deaths, and Marriages. After separate interviews with a close relative or friend and the general practitioner by a trained nurse interviewer, review of hospital records, and study of necropsy findings where available a panel of respiratory physicians determined whether the patient had suffered from asthma and whether the patient had died from asthma or its complications or treatment.⁸ If so, the panel reviewed the characteristics of the patient, the long term care, particularly over the year before death, the circumstances of the fatal episode, and the possibilities for intervention which might have prevented a fatal outcome.

After completion of data collection two of us had discussions with a member of the asthma mortality subcommittee of the British Thoracic Association, and subsequently one reviewed 15 representative New Zealand cases with two members of the subcommittee, who did not know the assessments of the New Zealand panel, to determine comparability of judgments regarding adequacy of management and preventability of death.

Results

DEMOGRAPHIC DATA

The verified mortality from asthma in 15-64 year olds of all races in New Zealand was 5.6/100 000 compared with 1.84/100 000 in England.⁶ As reported,⁷ death rates for asthma in the Maori and Pacific Island Polynesian populations were respectively 5.5 ($p < 0.01$) and 2.8 ($p < 0.05$) times higher than the rate for caucasians these higher rates accounted for 36% of the "excess" of the total New Zealand asthma mortality. The verified mortality in New Zealand caucasians aged 15-64 was 4.2 per 100 000 (table I), still more than twice that reported in England. The net accuracy of statistical coding of all cases studied did not differ significantly between the two countries.^{8,9}

CHARACTERISTICS OF PATIENTS AND THEIR ASTHMA

The age and sex distribution of the subjects who died was similar in the two countries (table II). There were no significant differences in the ages at onset or durations of asthma; in both countries about 80% of patients had had asthma for over 10 years. One third of patients dying of asthma in England had been free of symptoms for periods of three months or more in the year before death, but this was rare in New Zealand patients, only 6% of whom had mild asthma not requiring emergency visits to a general practitioner or hospital in the year before death. In England 39% of patients had had previous, sudden severe attacks, while in New Zealand 29% of patients had had life threatening episodes of asthma resulting in altered consciousness or documented hypercapnia. In one in 10 fatal cases in New

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TABLE I—Comparison of entry criteria, verified mortality rates, and accuracy of ICD coding of deaths from asthma in 15-64 year old caucasian subjects in New Zealand and England

	New Zealand	England
Study period	August 1981 to July 1983	January to December 1979
Referral criteria	"Asthma" or derivative in part I of death certificate or on coroner's report	"Asthma" anywhere on death certificate
Cases studied	185*	153
Population at risk	1 750 000	4 890 000
Deaths coded to asthma by National Health Statistics Centre (New Zealand) or Office of Population Censuses and Surveys	172	101
Verified deaths from asthma	147 (85% of coded deaths)	90 (89% of coded deaths)
Yearly verified asthma mortality per 100 000	4.20	1.84
Net accuracy of ICD coding of all cases	81%	76%

*These data differ from those of New Zealand national asthma mortality study,⁷ which included non-whites and an age range of greater than 15-64.

TABLE II—Characteristics of patients and their asthma. Figures are numbers (percentages) of patients

	New Zealand (n=147)	England (n=90)
Male	74 (50)	41 (46)
Age below 45	55 (37)	38 (42)
Duration of asthma over 10 years	116 (79)	72 (80)
Symptom free for over three months in year before death	9 (6)	30 (33)
Chronic asthma	138 (94)	60 (67)
Reversible airflow obstruction	77/85 (91)	22/27 (81)
Atopic (by history or skin tests)	105 (71)	52 (58)
Previous severe attacks*	42 (29)	35 (39)
Admitted to hospital:		
At any time	100 (68)	58 (64)
In year before death	54 (37)	19 (21)
Previous mechanical ventilation	14 (10)	3 (3)

*Described as sudden, severe attacks in England: defined as life threatening attacks with altered consciousness or documented hypercapnia in New Zealand.

Zealand the patient had previously been ventilated for life threatening asthma. Proportionately more patients in New Zealand than in England had been admitted to hospital for asthma in the year before death. In both countries most of the patients who died were atopic and most of those tested had reversible airflow obstruction

MANAGEMENT AND ASSESSMENT OF ASTHMA

Patient compliance with treatment as judged by the reviewing panel was unsatisfactory in more than half of the patients in both countries, though general practitioners rated compliance as better in many cases (table III). A

TABLE III—Patient compliance and functional assessment. Figures are numbers (percentages) of patients

	New Zealand (n=147)	England (n=90)
Patient fully cooperative:		
General practitioner assessment	95 (65)	62 (69)
Panel assessment	54 (37)	42 (47)
Unreliable in drug taking	53 (36)	23 (26)
Reluctant to seek medical help	54 (37)	26 (29)
Smokers:		
Current	31 (21)	22 (24)
Past	49 (33)	19 (21)
Recent or frequent change of general practitioner	26 (18)	19 (21)
Lung function tests performed	85 (58)	27 (30)
Serial peak flow readings	31 (21)	4 (4)

somewhat greater proportion of New Zealand patients were considered unreliable in taking medications and reluctant to seek help. Lung function tests were more often available for New Zealand patients, though less than a quarter had used peak flow meters; considerably fewer patients in England had used peak flow meters. One in five patients in each country had had frequent or recent changes of general practitioner with consequent interruption of primary medical care.

DRUG TREATMENT

Comparatively more New Zealand patients with fatal asthma had used theophylline, inhalational corticosteroid, and nebulised bronchodilator, but systemic corticosteroids were less frequently used than in England (table IV). Treatment as prescribed by the general practitioner comprised

TABLE IV—Regular drug treatment prescribed for 15-64 year old caucasian subjects who died of asthma in New Zealand and England. Figures are numbers (percentages) of patients

	New Zealand (n=147)	England (n=90)
β Agonist (oral or inhaled)	144 (98)	85 (94)
Theophylline	93 (63)	37 (41)
Ipratropium bromide	29 (20)	*
Cromoglycate	22 (15)	*
Inhalational corticosteroid	77 (52)	30 (33)
Systemic corticosteroids (daily or short courses)	56 (38)	55 (61)
Bronchodilators only	40 (27)	25 (28)
Domiciliary nebuliser	37 (25)	0

*Data not given.

both bronchodilator and anti-inflammatory agents in 49% of cases, but in many of these patients the dosages may have been inadequate, as lung function was not assessed. A home nebuliser was used by a quarter of the New Zealand patients for occasional or regular administration of a β sympathomimetic, but many patients, including more than half of those with previous life threatening attacks, did not have access to oxygen or to a nebuliser. In England no patient dying of asthma had a home nebuliser. In both countries few relatives seemed to have a clear grasp of how to identify and manage severe attacks ("crisis plan").

CIRCUMSTANCES OF FATAL ATTACK

In both New Zealand and England the duration of the final attack varied between minutes and several days; in a quarter of cases the patient died in less than one hour from the apparent onset of the attack (table V). In New Zealand 31% of patients were known to have died within three hours of the apparent onset; a further 19% probably died in under three hours, but as they were found dead the time of death was less certain. Similar proportions of patients died at weekends and at night in the two countries. Fewer than half of all patients called their general practitioner or a deputy medical service. Only one fifth of patients in New Zealand called an ambulance compared with 38% in England; possibly as a result 14% died en route to medical care, mostly in private cars. Important delays in seeking medical help were evident in 37% of New Zealand cases, whereas in England 54% of patients were considered to have delayed or failed to call help.

We found no evidence in caucasian New Zealand patients of excess theophylline usage in the fatal attack, and only five patients appeared to have used a β agonist in doses exceeding those used regularly in hospital inpatients with acute severe asthma—namely, nebulisation of salbutamol or fenoterol 2.5-5.0 mg every two hours. Cardiac arrhythmia due to drugs in the presence of hypoxia might explain the very few extremely sudden deaths, but we have no evidence for or against this hypothesis. As in England, however, there was evidence of underusage of systemic corticosteroids, both during the period of gradual deterioration leading to the final attack and at the time of

medical intervention (46% of those treated during the attack were given little or no corticosteroid). In New Zealand 50 patients (34%) had had a recent attack which was poorly assessed or poorly treated and 18 (12%) had recently stopped or rapidly reduced their dose of oral steroids. Four patients were taking β adrenergic blocking drugs, which in three contributed directly to death. There were no deaths after ingestion of aspirin or non-steroidal anti-inflammatory drugs. Twenty patients used antianxiety or antipsychotic drugs. Sedatives were given in only one of the fatal asthmatic attacks studied.

TABLE V—Events of fatal attack. Figures are numbers (percentages) of patients

	New Zealand (n=147)	England (n=90)
Time of death†:		
Weekdays (Mon-Fri 0800-2000)	31 (21)	16 (18)
Weeknights (Mon-Fri 2000-0800)	54 (37)	22 (24)
Weekends (Fri 2000 to Mon 0800)	58 (39)	37 (41)
Duration of fatal attack:		
<1 h	34 (23)	23 (26)
1-3 h	12 (8)	10 (11)
Help called:		
General practitioner	66 (45)	41 (46)
Ambulance	31 (21)	34 (38)
Help received:		
General practitioner	32 (22)	15 (17)
Ambulance	7 (5)	*
Delay in seeking help	55 (37)	49 (54)
Delay in medical response	38 (26)	25 (28)
Inadequate medical emergency care‡	49 (33)	29 (32)
Patient found dead	28 (19)	13 (14)
Death in hospital	19 (13)	13 (14)

*Data not given.

†Unknown for 4 (3%) cases in New Zealand; not stated for 15 (17%) cases in England.

‡Failure to assess severity, begin steroids, or admit urgently.

PREVENTABLE DEATHS

The subcommittee of the British Thoracic Association determined that 86% of the deaths from asthma in England were associated with factors whose avoidance might have led to a different outcome (table VI). A similar

TABLE VI—"Avoidable" and "unavoidable" asthma mortality in New Zealand and England

	New Zealand 1981-3 (n=147)	England 1979 (n=90)
Verified asthma mortality*	4.20	1.84
Avoidable deaths (No (%))	98 (67)	77 (86)
Avoidable deaths (rate)	2.83	1.57
Doubtfully avoidable (No (%))	9 (6)	3 (3)
Unavoidable deaths (No (%))	40 (27)	10 (11)
Unavoidable deaths (rate)	1.14	0.20

*All rates are deaths/100 000/year.

judgment was made for 67% of the deaths in caucasian patients of the same age group in New Zealand. Discussions with two members of the British Thoracic Association's subcommittee and detailed review of the circumstances of 15 representative New Zealand cases by the two British Thoracic Association physicians who were unaware of the assessments made by the New Zealand panel assured us that, so far as was possible, these judgments were based on similar criteria in each country. The most common problem associated with an "avoidable" death in New Zealand was underassessment of severity of chronic asthma before the onset of the fatal attack (37% of all cases). Twelve patients recently given oral corticosteroids were not followed up by a doctor or tested for lung function, nor did they begin treatment with inhalational steroids. In 26 cases there was opportunity to give or increase oral corticosteroids during the early stages of the fatal episode but this was not done; instead antibiotics were often prescribed. Delays in attendance or in instituting appropriate treatment by doctors or ambulances were identified; in one instance a hospital clinic gave poor advice leading to delay. On the other hand, 37% of all patients delayed seeking medical help when their usual treatment was unavailable or ineffective. Treatment in hospital

was inadequate in eight cases because of delay in the accident and emergency department, inadequate assessment, or inadequate corticosteroid treatment.

Given all the circumstances, 40 (27%) of the deaths in New Zealand were considered by the panel to have been "unavoidable" compared with 10 (11%) in England. In 27 cases (18%) the patient apparently suffered a precipitous attack despite good long term management, while in five asthma worsened abruptly despite initiation of appropriate treatment. Four patients were found dead, having apparently been well shortly beforehand. Four died in hospital of irreversible end stage disease despite intensive treatment.

Eight deaths in the New Zealand series have not been included here. Five patients rarely if ever sought medical help unless in extremis or were totally non-compliant with advice given. In two deaths the circumstances were such that we were unable to determine whether death might have been avoided, and in one case the circumstances of death could not be ascertained.

Discussion

National statistics show that for several years the mortality from asthma has been substantially higher in New Zealand than in England and Wales and many other countries. This has been verified by two recent studies in New Zealand and England.^{6,7} In this comparison of mortality between countries we were unable to eliminate all potential bias in collection, analysis, and interpretation of data but attempted to minimise this by ongoing consultations among investigators. The two to three year interval between the studies may have accounted for some of the differences in drug treatment, particularly the use of nebulisers, as discussed more fully elsewhere.¹⁰ In the regional study in England all interviews were conducted by one physician, whereas for logistic reasons interviews in the nationwide New Zealand study were conducted by six trained nurses; in both countries interviews were followed by careful review by a medical panel. Retrospective comparison of the independently developed questionnaires showed a close similarity; the few differences are explained above. Bias in subjective interpretation of adequacy and appropriateness of long term and short term care based on recall by relatives and medical records is less easily determined. Nevertheless, from our consultations and the review of representative New Zealand cases by two members of the British Thoracic Association's subcommittee we believe that such differences were small and not systematic. Racial and cultural differences between countries may be another source of bias. We excluded cases in Maoris and Pacific Island Polynesians from the comparison; the remaining caucasian population was genetically and culturally closely related to the caucasian population of the United Kingdom.

The national asthma mortality study has shown that the higher reported rates in New Zealand compared with England were not due to a greater proportion of errors of certification or coding.^{8,9} The methods of case review in each country excluded any effect from the introduction of the ninth revision of the International Classification of Diseases in 1979.¹¹ The verified mortality of 4.2/100 000 New Zealand caucasians aged 15-64 confirmed the New Zealand mortality from asthma in 1981-3 to be more than twice that of England in 1979. Had the study by the British Thoracic Association been contemporaneous with the New Zealand study this difference might have been slightly less, as asthma mortality is increasing slowly in England and Wales,¹² but this change with time is small compared with the substantial difference between the two countries.

If data from the two regions studied in England are applicable nationally, and if the judgments made about whether or not deaths were preventable were comparable between countries, then the rate for "unavoidable" mortality from asthma was considerably greater in New Zealand than in the United Kingdom (table VI). Without both groups undertaking an independent review of all cases studied in both countries we cannot be certain that the same judgments would be made on all cases, but the two members of the British Thoracic Association's subcommittee who reviewed 15 representative New Zealand cases without knowledge of the New Zealand panel's assessment made identical judgments on which deaths were associated with "avoidable" factors. These factors included under-assessment of severity of chronic asthma resulting in inadequate long term care, poor patient compliance with treatment (often

associated with psychological problems and smoking), poor use of primary medical care, delay in calling for help in circumstances of increasing asthma, and underassessment of severity and inappropriate treatment of the acute attack.

Identified inadequacies in the long term management of patients with severe asthma in New Zealand were similar to those reported in England.^{6,13,14} Probably many of the patients who died of asthma had poorly recognised chronic airflow limitation which could have been reversed or improved with more aggressive treatment, including oral corticosteroids.

Reluctance to initiate or increase steroid treatment for acute attacks and failure to monitor response to such treatment when it was used were common. An arbitrary five or seven day course of prednisone without subsequent clinical and functional review of the patient is dangerous: it may fail fully to reverse the airflow obstruction and may leave the patient susceptible to a further exacerbation of asthma as treatment is withdrawn. Instead, prednisone 30-60 mg daily should be maintained for up to two weeks, until the peak expiratory flow returns to normal (or to the patient's known maximum) and there is minimal diurnal variation.¹⁵ When the prednisone dose is reduced peak flow measurements should be continued as well as clinical review and dose reduction halted if there is deterioration. Failure to initiate or increase inhaled steroids during withdrawal of oral steroids was another common error in management of the fatal cases in New Zealand.

The subcommittee of the British Thoracic Association recommended nebulised bronchodilator treatment as probably the best emergency treatment for acute asthma.⁶ In that study no patient had used a home nebuliser during the fatal attack. In New Zealand, perhaps because the study was undertaken two years later, and possibly because of a greater severity of asthma, nebulisers were prescribed for a quarter of those who died. In at least 12 instances over-reliance on a nebuliser led to a delay in seeking medical help or initiating other action.¹⁰ Grant was concerned about the high prevalence of use of nebulisers in New Zealand, particularly without peak flow monitoring or availability of oxygen.⁵ We emphasise the need for careful patient education in the use of nebulisers and the need for peak flow monitoring and an effective crisis plan for all patients requiring this form of treatment. As reported elsewhere, however, we believe that misuse of nebulisers at home contributed only slightly to asthma mortality in New Zealand.¹⁰

We found no direct evidence for bronchodilator drug toxicity, with no documented arrhythmias in patients admitted to hospital and no excessive theophylline doses or raised serum theophylline concentrations. Nor did we find that emergency management, when given, was hampered by the inability to use parenteral aminophylline in patients taking oral sustained release theophylline, which was prescribed more frequently in New Zealand than in England. The greatest increase in mortality in younger patients occurred three years before the abrupt increase in sales of anti-asthma drugs,³ making an association between increased treatment and mortality unlikely. While the descriptive nature of this study does not allow us categorically to negate suggestions of toxic drug interaction,⁴ inadequate systemic corticosteroid treatment seemed a more likely explanation for part of the higher mortality in New Zealand. Patients dying of asthma in New Zealand were more frequently prescribed theophylline and inhalational corticosteroids than those dying in England, but oral steroids were less frequently used. Whether this pattern of drug usage applies to the treatment of asthma generally in each country is unknown.

Two further differences between New Zealand and England which may have affected management and hence mortality deserve comment. The fee that New Zealand patients pay for each consultation with a general practitioner may have been a disincentive to regular medical care and to seeking help in the early stages of a severe attack; however, this was rarely commented on in interviews. Similarly, though access to health care may be somewhat less immediate in parts of New Zealand than in the regions

studied in England, remoteness from care was a factor in only 7% of all deaths. Deaths were not classified as unavoidable simply on the basis of remoteness from care.

The fall in asthma mortality in New Zealand in 1983, when our study ended, may have reflected an increased awareness of asthma mortality both within the profession and among the public with consequent improved management. Nevertheless, we remain concerned about the higher mortality compared with other countries. This is not an artefact of certification and may not be fully explained by the identifiable defects of management. The apparently higher rate of "unavoidable" deaths in New Zealand suggests that there are other factors which must be considered, including a change in severity of asthma. The anecdotal experience of immigrant physicians treating asthma in different countries,¹⁶ the increased prevalence and severity of asthma in Tokelauan immigrants to New Zealand,¹⁷ the sharp increase in use of antiasthma drugs in New Zealand,³ and this comparison of the New Zealand and English studies of asthma mortality suggest that as yet unknown environmental factors may have had an adverse effect on asthma mortality in New Zealand. On the other hand, this study does provide evidence for quantitative differences between New Zealand and England in some aspects of management of asthma, including drug use and patient willingness to present for medical care and review. We must leave open the possibility that these differences might account for at least part of the excess New Zealand mortality from asthma.

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