Demographic characteristics of patients with severe life threatening asthma: comparison with asthma deaths

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Abstract

***Background*—Studies of mortality from asthma have suggested that a very severe asthma attack identifies a group at greatly increased risk of subsequent death from the disease. This study compares the demographic characteristics of asthmatic patients who required management in an intensive care unit for a severe life threatening attack between 1981 and 1987 with a group who died of asthma between 1980 and 1986. The outcome of the group admitted to an intensive care unit is described.**

***Methods*—The groups comprised all cases aged between 15 and 49 years arising from the Auckland Area Health Board (AAHB) population who required admission to an intensive care unit for asthma between 1981 and 1987 (n = 413) and all deaths from asthma in those aged 15 to 49 years arising from the New Zealand population between 1980 and 1986 (n = 466). Details of age, sex, and information on the day and month of the attack were collected. For the group requiring admission to an intensive care unit, outcome in terms of mortality and readmission to intensive care was determined.**

***Results*—The age distributions of the two groups were dissimilar, with the severe life threatening attack group having an excess of asthmatic patients under 30 years old. The distribution of events by calendar month was uniform in both groups, but there was an unexpected increase in frequency of attacks on Sundays in both groups. Over the study period, mortality fell from 5·3 per 100 000 to 3·5 per 100 000 but the admission rate to intensive care increased from 10·8 per 100 000 to 17·9 per 100 000. At least 24% of asthma deaths occurring in the AAHB region during the study period had previously experienced a severe life threatening attack.**

***Conclusions*—The similarities between the groups suggest that asthmatic patients who experience severe life threatening attacks are likely to come from the same subgroup of the asthma population as those who die. The group who experience severe life threatening attacks are at high risk of subsequent morbidity and mortality and further studies may produce information relevant to reducing mortality from asthma.**

(*Thorax* 1993;48:1105–1109)

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Reprint requests to:
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Received 27 August 1992
Returned to authors 11 November 1992
Revised version received 12 May 1993
Accepted 25 May 1993

The mortality from asthma in New Zealand has been considerably higher than in other countries for many years.[1] As in other countries there was an increase in mortality from asthma in New Zealand in the late 1960s, but by contrast with other countries this rate did not return to baseline and a further pronounced increase in mortality occurred in the late 1970s.[2 3] In persons aged 5 to 34 years it rose from 1·3 per 100 000 in 1974 to a sustained rate of 3·0 to 4·2 per 100 000 between 1977 and 1982.

A national study of deaths from asthma in New Zealand[4] found that 25% of those who died had previously suffered a severe attack of asthma. In a case-control study,[5] a previous life threatening attack, defined as "an attack where consciousness has been disturbed or appreciable hypercapnia has been recorded", carried the highest relative risk for death when those who died were compared with hospital and community controls.

Although all life threatening attacks of asthma are medical emergencies, there is a considerable variation in severity within this definition. In New Zealand most asthmatic patients experiencing such attacks respond rapidly to treatment and are managed in general hospital wards without specialist respiratory guidance. The most severe and refractory cases, severe life threatening attacks, require initial management in an intensive care unit. In New Zealand asthma is responsible for 12% of admissions to intensive care units compared with less than 3% in the United States.[6]

Our hypothesis is that asthmatic patients who die and those who survive severe life threatening attacks are derived from the same small subgroup of the asthma population. This study compares the demographic characteristics of asthmatic patients who have experienced a severe life threatening attack with those who have died of asthma. The outcome of the first group in terms of mortality and recurrent severe life threatening attack is documented.

Methods

Two groups of asthmatic patients were studied. The first group included all deaths in

New Zealand attributed to asthma (International Classification of Diseases (ICD) code 493) aged 15 to 49 years in the years 1980 to 1986. Date of birth, sex, date of death, and place of death were obtained from death certificate data supplied by the National Health Statistics Centre.

The severe life threatening attack group consisted of all patients normally resident in the Auckland Area Health Board (AAHB) region aged 15 to 49 years, and admitted to either of the two regional intensive care units treating patients with severe asthma from 1981 to 1987, with a principal diagnosis of asthma. The AAHB served an urban population of 889 000 in 1986, of which 471 000 were aged 15 to 49 years. Date of birth, sex, and date of admission were obtained from hospital chart records. Admission rates were calculated from population data supplied by the AAHB.

Only the first admission counted if an asthmatic patient was readmitted to an intensive care unit before discharge from hospital. Age and sex distributions were calculated from only the first admission for any patient during the study period. Admission rates were calculated from the first admission for any patient in a calendar year to reduce the bias caused by those who had frequent readmissions. The timing of events by month and day of the week was calculated from all admissions.

Comparisons between the groups were tested for significance with non-parametric statistical procedures. Differences in the age distribution of the groups were tested with the Kolmogorov-Smirnov two sample test. All other comparisons used the χ^2 two sample test. Significance was accepted at $p < 0{\cdot}05$.

Results

Data from 413 asthmatic patients who had 555 intensive care unit admissions and 466 patients who died from asthma were analysed.

The age distributions of the asthma death and severe life threatening attack groups were significantly different (fig 1). The asthma death group had a uniform distribution until 40 years of age when numbers increased. The severe life threatening attack group had a predominance of younger asthmatic patients with 45% being less than 25 years old.

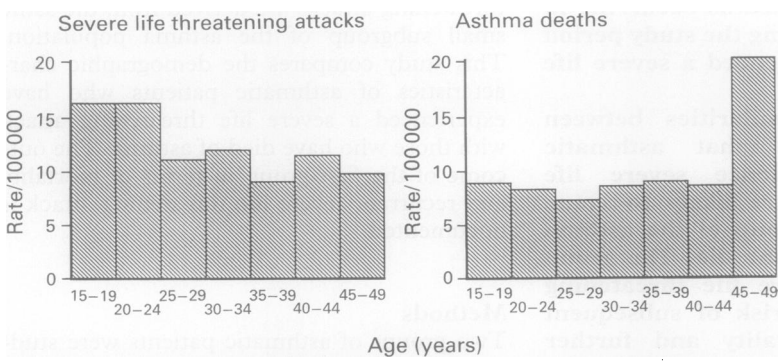

Figure 1 Age distribution of the asthma death and severe life threatening attack groups.

Females formed the majority of both groups, comprising 54% of the mortality group and 60% of the severe life threatening attack group (NS).

Figure 2 shows the month of death or admission. The distribution of events by month was not significantly different from uniform in either group. When seasons rather than months were analysed, there was a significant increase in the frequency of severe life threatening attacks in autumn (March to May) compared with the remainder of the year. No seasonal difference was found in the mortality group. The increase in frequency of severe life threatening attacks in autumn was due to those under 25 years of age. Above the age of 25 no increase in frequency was seen during autumn months. Of those under 25 years in the asthma death group there was a small increase in frequency during autumn but it did not reach statistical significance.

Severe life threatening attacks and asthma deaths were more likely to occur on Sundays than other days of the week (fig 3). This was statistically significant in both the severe life threatening attack ($\chi^2 = 6{\cdot}3$, $p < 0{\cdot}02$) and asthma death ($\chi^2 = 7{\cdot}8$, $p < 0{\cdot}01$) groups.

National asthma mortality, AAHB asthma mortality and rates of admission to intensive care units because of asthma are shown in fig 4. The asthma mortality rate in the AAHB population was similar to the national population over the period of the study. National mortality decreased from 5·2 per 100 000 in 1980 to 3·5 per 100 000 in 1986. By contrast, AAHB admission rates to intensive care units for asthma increased substantially from 10·8 per 100 000 in 1981 to 17·8 per 100 000 in 1987. This increase was greatest between 1981 and 1984.

The extent of overlap between the groups was examined by studying those who died of asthma after a severe life threatening attack. During the study there were 27 deaths due to asthma in the severe life threatening attack group. Of these, seven suffered irreversible cerebral hypoxic damage from cardiopulmonary arrest during the index attack and died before discharge from hospital. The group of 20 asthmatic patients who died after discharge was too small to compare statistically with the remainder of the group, but there were no obvious differences in age or sex. Almost one third of deaths occurred within three months and two thirds within a year of the index attack. Excluding those who died before discharge from hospital, the mortality of the severe life threatening attack group two years after the index attack was 7·5%. Of the 93 asthma deaths in the AAHB region from 1981 to 1986, 22 (24%) had been admitted to an intensive care unit with a severe life threatening attack since 1981.

Readmission to an intensive care unit with asthma was common with 53 (13%) asthmatic patients having one readmission and 24 (6%) having multiple readmissions during the study period. About two thirds of first readmissions occur within a year of the index admission and almost one third occur within

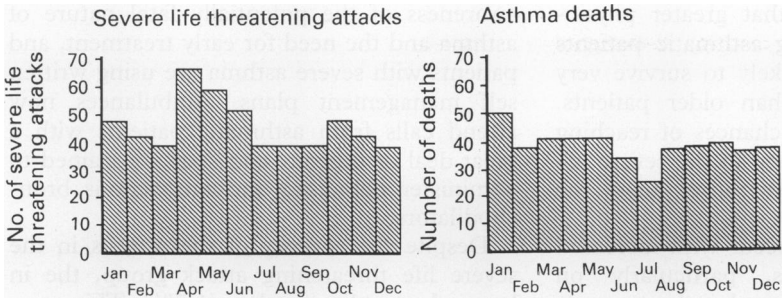

Figure 2 Month of asthma death and severe life threatening attack.

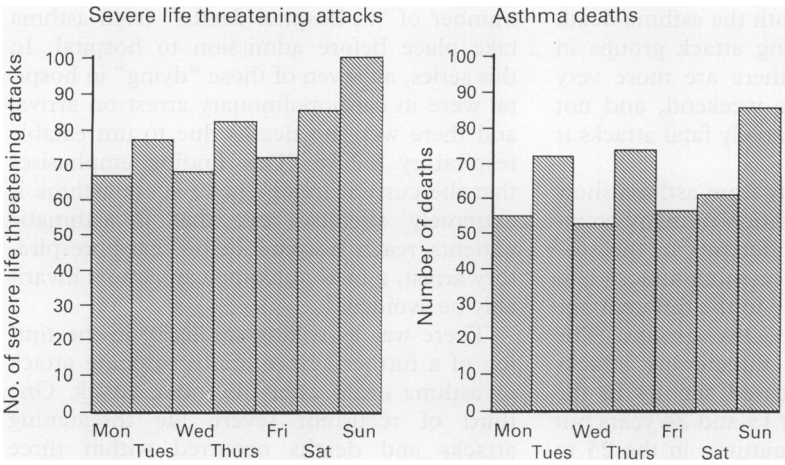

Figure 3 Day of asthma death and severe life threatening attack.

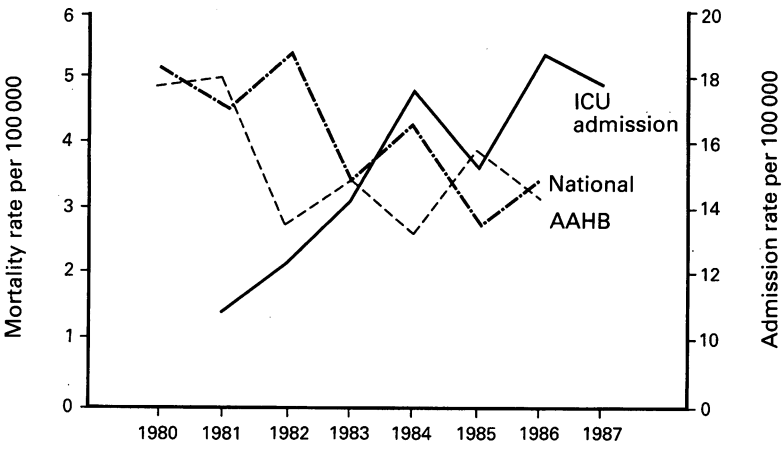

Figure 4 New Zealand asthma mortality, Auckland Area Health Board (AAHB) asthma mortality rate, and AAHB intensive care unit (ICU) asthma admission rate.

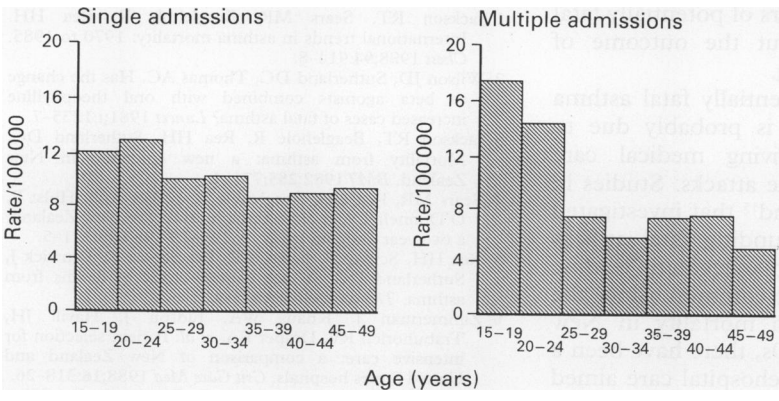

Figure 5 Age distribution of asthmatic patients having single and multiple severe life threatening attacks.

three months. Those at highest risk of readmission were patients less than 25 years of age (fig 5). There was no evidence of a decreasing rate of readmission during the study.

To determine whether there was a change in admission policy which, in turn, may have caused a change in admission rate, initial arterial blood gas results were used as indices of severity of the index attack and values from patients admitted in 1982 were compared with those admitted in 1985. The mean (SE) values were virtually identical in 1982 (pH = 7·08 (0·15), Pa_{CO_2} = 10·4 (4·3)) and 1985 (pH = 7·10 (0·17), Pa_{CO_2} = 11·0 (5·5)).

Discussion

Attacks of asthma requiring management in an intensive care unit represent the most severe end of the spectrum of acute asthma and patients experiencing these attacks would almost certainly die without prompt medical intervention. It is our contention that outcome for those experiencing such attacks is largely dependent on the timing of reaching medical care and that they arise from the same high risk subgroup as those who die of asthma. This hypothesis is supported by the similarity of demographic features found in this study and the fact that, of those dying of asthma in Auckland during the period of the study, 24% had experienced a prior severe life threatening attack.

The data on the two groups compared in this study were obtained from different sources, but valid comparisons can be made. Although this study compares a group from the AAHB population with a group arising from the national population, the AAHB serves about 28% of the national population. The characteristics of the AAHB population are similar to those of the national population and mortality from asthma is virtually identical (fig 4). The age range chosen was to optimise the certainty of a diagnosis of asthma and reduce confusion with other illness in the very young or elderly. Data on asthma mortality from the source used has previously been found to have an accuracy of not less than 82% in this age range.[7] The two intensive care units from which the severe life threatening attack group was assembled use computerised data bases and are the only units in the Auckland area treating acute asthma. Therefore, this group includes all cases of asthma requiring management in intensive care units arising from a defined population.

The periods of study of the two groups are not exactly concurrent. This was due to the mortality data for 1987 not being available at the time of the study. This factor is unlikely to affect the comparisons of demographic characteristics as they were stable throughout the study period in both groups.

The severe life threatening attack group is younger than the asthma death group, with particularly large numbers in the 15 to 24 year age group. The most likely explanation

for this discrepancy is that greater physiological reserves of young asthmatic patients may make them more likely to survive very severe asthma attacks than older patients. This may increase their chances of reaching medical care and appearing in the severe life threatening attack group rather than the mortality group.

Deaths from asthma occur with increased frequency at weekends, particularly on Sundays. This observation has been made previously in New Zealand[4] and in the UK[8] where 41% of deaths from asthma occur between Friday night and Monday morning. The similar findings in both the asthma death and severe life threatening attack groups in this study suggest that there are more very severe attacks during the weekend, and not that the outcome of potentially fatal attacks is worse.

Morbidity and mortality from asthma show pronounced seasonal variation in many countries.[9-13] The apparent difference in the seasonality of severe life threatening attacks and deaths from asthma is due to the different age distributions of the respective groups. The frequency of severe life threatening attacks and asthma deaths increased slightly in the autumn in those between 15 and 24 years but no increase occurred in autumn in the 25 to 49 year age group. Seasonal factors do not seem to play a significant part in mortality from asthma or admission to intensive care units with asthma among those over 25 years of age in New Zealand.

Mortality from asthma increased in many countries during the early 1980s.[14] Although there is considerable fluctuation due to the small size of the New Zealand population and low absolute numbers of deaths each year, there has been a downward trend in mortality in the 15 to 49 year age group between 1980 and 1986. By contrast, admissions to intensive care units in Auckland because of asthma have risen considerably from 1981 to 1986. This increase could have been due to a relaxation of intensive care unit admission policy, but the lack of change in indices of acute severity between 1982 and 1985 suggests that a change in admission policy cannot fully account for the change in admission rates. If the sum of deaths and severe life threatening attacks is considered to represent all the very severe asthma attacks occurring in the community, increased numbers of potentially fatal attacks are occurring but the outcome of these attacks is improving.

If the outcome of potentially fatal asthma attacks is improving, it is probably due to asthmatic patients receiving medical care more rapidly during acute attacks. Studies in the UK[8] and New Zealand[15] that investigated the circumstances surrounding fatal attacks found that mistakes in management leading to delays in treatment are common. Since the recognition of very high mortality in New Zealand in the early 1980s, there have been a number of changes in prehospital care aimed at decreasing delays in treatment. Mass education campaigns have heightened public awareness of the potentially fatal nature of asthma and the need for early treatment, and patients with severe asthma are using written self management plans. Ambulances now attend calls from asthmatic patients with a great deal of urgency and staff are trained to administer nebulised and intravenous bronchodilators.

Despite the severity of the attacks in the severe life threatening attack group, the in hospital mortality was low (1·5%). This compares with estimates of zero to 1·3% in other studies of in hospital deaths.[16-20] It was noted by Cochrane and Clark[18] that a substantial number of "in hospital deaths" from asthma take place before admission to hospital. In this series, all seven of those "dying" in hospital were in cardiopulmonary arrest on arrival and there were no deaths due to untreatable respiratory failure. This finding emphasises that the current treatment of acute asthma is extremely effective and that if asthmatic patients reach hospital before cardiorespiratory arrest, a fatal outcome can almost invariably be avoided.

There was a striking similarity in the timing of a further severe life threatening attack or asthma death after the index attack. One third of recurrent severe life threatening attacks and deaths occurred within three months, and two thirds occurred within a year of discharge from hospital. Thus risks of morbidity or mortality from asthma persist after successful treatment of an acute attack and are highest in the subsequent year. This problem has been identified previously[20 21] but premature discharge from hospital before resolution of the pathophysiological abnormalities is considered an unlikely explanation for our results. Whether it is due to persistence of severe airway hyperresponsiveness or continuation of other risk factors is not clear from our study but it is obviously important.

This work was supported by the Medical Research Council of New Zealand. Dr GN Richards was supported by the Medical Research Council of New Zealand and the New Zealand Asthma Foundation. We thank the staff of the intensive care units of Auckland and Middlemore Hospitals for providing access to their patient databases, Josephine Ryan of the National Health Statistics Centre for compiling the mortality data, Alistair Stewart of the Auckland Medical School for his advice on statistics, and Mrs Kathy Gallimore for her assistance in preparing the manuscript.

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