Seasonal variations in hospital treatment periods and deaths among adult asthmatics

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ABSTRACT: The purpose of this study was to examine possible seasonal variations in relations between hospital treatment periods and in deaths (asthma-related and other) among adult asthmatics.

Out of a total of 364,871 asthma-induced hospitalization periods (diagnosis No. 493, International Classification of Diseases) recorded in the hospital discharge register maintained by the National Research and Development Centre for Welfare and Health during 1972–1992, all of those applying to persons aged >24 yrs during 1987–1992 were analysed here. The discharge file was linked to the register of deaths on the basis of the patients’ social security numbers in order to analyse all deaths among the same patients during 1987–1993.

A total of 81,243 asthma-related treatment periods were analysed. The monthly variation in the number of such periods showed a peak in January (18.2% above the mean number of monthly deaths in the study period) and a trough in July (26.1% below the mean). Of the 7,622 hospitalized asthmatics who died during the period examined here, 1,274 died of obstructive pulmonary diseases, with asthma as the primary cause in 489 cases. The majority of the deaths were caused by cardiovascular diseases. Mortality was highest in January (+14.7%) and lowest in August (-12.3%).

The similarity in the seasonal variation observed between the treatment periods and deaths recorded for adult asthmatics may be taken to indicate a genuine need for treatment.


Asthma morbidity has increased in recent decades [1, 2]. Factors known to aggravate asthma and increase the need for hospital treatment include epidemics of infectious diseases [3], pollen [4], cold air [5] and air pollution [6]. The rise observed in the number of hospitalization periods for asthmatics is attributable not only to a real increase in the disease but also to the efficient organization of treatment and patients’ greater awareness of the services available. Asthma is now recognized as a widespread disease and a substantial cause of death. Research carried out in New Zealand points to a rise in the numbers of asthma-induced hospitalization periods, accompanied by an increase in asthma-related deaths [7], whereas subsequent observations have suggested a decline in the number of deaths in the presence of high rates of hospital treatment [8, 9]. A slight decrease in the number of asthma-related deaths has also been reported in Finland [10]. Survival among patients with asthma but no other lung disease has been found to be not significantly different from that expected [11], although in a recent Finnish study mortality of adults with asthma was found to be increased as compared with nonasthmatics [12].

The existence of a National Hospital Discharge Register in Finland enables the use of hospital services by asthmatics to be monitored. The aim of the current investigation is to examine whether any connection exists between fluctuations in asthma-related hospitalization periods and those in deaths of previously hospitalized asthmatics.

Materials and methods

The National Research and Development Centre for Welfare and Health is provided with registration data on all patients treated in hospital in Finland, including their diagnoses. All treatment periods between 1972 and 1992 with asthma as the main diagnosis (International Classification of Disease (ICD), Eighth Revision 1972–1986 and Ninth Revision 1987 onwards, rubric 493) were collected from the register, yielding a total of 364,871 entries. As the Ninth Revision of the Disease Classification distinguishes between the various types of asthma, the period during which this version was in use, January 1, 1987–December 31, 1992, was selected for examination here. All treatment periods for asthmatics aged >24 yrs with discharges from January 1, 1987 onwards were analysed to determine the seasonal variation. The total number of these periods was 81,243. The yearly average number of hospitalizations was 13,541 (11,476–14,276). Males accounted for 42% of asthma hospitalizations.

Mortality among hospitalized asthmatics was examined within the group of “new asthma admissions”; defined as persons who had had their first treatment period on or after January 1, 1977, and in any case before the end of 1992. Mortality was analysed during the time period January 1, 1987–December 31, 1993. The total number of deaths was 7,622, the yearly average was 1,089 (839–1,291). Males accounted for 52% of deaths.
The data on "new asthma admissions" collected from the discharge register were linked to the death register by patients' social security numbers. The underlying cause of death was recorded by the ICD code. The seasonality of deaths was analysed in three groups: firstly all deaths (ICD 000–999); secondly, obstructive deaths including chronic obstructive pulmonary disease (COPD) (chronic bronchitis 491, emphysema 492 and chronic, nondefined broncho-obstruction 496) and asthma (493); and thirdly, asthma (493) deaths alone.

The numbers of treatment periods and deaths per year and per month in each year were calculated, taking the month of arrival or of death as the index month and the year of discharge or of death as the index year. The seasonality of these monthly hospital admissions and deaths was analysed using the X11 ARIMA procedure. The Auto-Regressive Integrated Moving Average (ARIMA) model chosen was (0,1,1)(0,1,1) with natural logarithmic transformation [13]. The variation in the lengths of the months was included in the seasonal factor. The seasonal adjustments were multiplied by the seasonally adjusted series to obtain the observed values. The final monthly seasonal factors (3×5 moving average selected) from 1987 onwards were calculated for each month in each year and the resulting values averaged for each month over the whole period studied and expressed as percentage deviations from the mean number of monthly deaths. The statistical analyses were performed with the SPSS for Windows Trends program, release 6.1 (SPSS, Chicago, IL, USA) [14]. The F-test was used to analyse the seasonal factors in each month by sex and age groups.

Results

Treatment periods

A total of 81,243 asthma-induced treatment periods (42.0% for males) were recorded for 1987–1992, the interval over which seasonal variations were examined. The average age (± SD) of the male asthmatics was 58±14 yrs and that of the females 60±15 yrs. A significant seasonal variation was observed (fig. 1) in that a large number of treatment periods were recorded between January and May, followed by a sharp decline during the summer months, and a rise during the autumn to a point somewhat below the winter level. The number of treatment periods was greatest in January (average for January in the study years of 1,348), which was 18.2% above the mean number of monthly deaths, and lowest in July (average of 817), 26.1% below the mean.

There was no difference between males and females in asthma hospitalizations. The pattern of seasonality was similar in all three age groups (fig. 2). Each age group showed significant seasonality. In the youngest age group, 25–44 yrs, there was an 18.7% winter excess in asthma hospitalizations, in the age group 45–54 yrs 28.8% and in the age group ≥55 yrs 10%. The trough in all age groups occurred in July: 37.3% below the average in the 25–44 yrs age group, 33.3% in the age group 45–54 yrs and 16.7% in the age group ≥55 yrs.

Deaths

Of the total of 84,228 "new asthma admission" patients, 4,176 died during the period January 1, 1977–December 31, 1986, and 7,622 of the remaining 80,052, who were >24 yrs, had died by the end of 1993. The cause of death was obstructive pulmonary disease (diagnoses 491–493, 496) in 1,274 of cases. COPD, chronic bronchitis and emphysema (diagnoses 491, 492 and 496) accounted for 785 of these deaths and asthma (493) for 489.

Of the asthmatics treated in hospital during the period concerned, 7,622 died aged >24 yrs, 52.2% of these being males. The most common cause of death was cardiovascular disease. The average age of the males at death was 69±11 yrs and that of females 75±11 yrs. Mortality was highest in December and January (average 103), 14.7% above the mean number of monthly deaths, and lowest in August (average 80), 12.3% below the mean (fig. 3).

A total of 1,274 persons died of obstructive pulmonary disease, 62.2% of them males, average age 70±11 yrs; that of females being 73±11 yrs. These deaths reached a peak in December and January (average 19), 28.8% above the
mean number of monthly deaths, but were infrequent from May to November. The lowest level was recorded in August (average 11), 21.1% below the mean.

A total of 489 persons died of asthma during the same period, 40.9% of them males, whose average age at death was 65±14 yrs compared with 74±12 yrs for females. Most of the deaths occurred in early winter, December–January and spring. Asthma-related mortality was highest in February (average 7), 21.0% above the mean number of monthly deaths, and lowest in August (average 4), 17.2% below the mean.

Discussion

The present findings regarding seasonal fluctuations in asthma-related treatment periods during 1987–1992 and the corresponding variations in deaths among hospitalized asthmatics during 1987–1993 point to an obvious correspondence, although with a certain time-lag, in deaths from all obstructive pulmonary diseases, including asthma, and in asthma deaths when the highest peaks and lowest trough were concerned. Deaths among asthmatics were more often caused by other obstructive pulmonary diseases than by asthma itself.

This register-based investigation involved combining the information on asthma-related treatment periods and deaths from different national registers by reference to patients’ social security numbers. The Hospital Discharge Register covers all hospital admissions in Finland, and the correspondence between its diagnosis data and patient records is good, as high as 95% [15]. Our own working group earlier observed that the rise in the number of treatment periods recorded for adult asthmatics in the 1980s was due to the repeated admission of the same patients [16], while other investigations have attributed the quantity of hospital treatment provided and changes in this to a rise in the prevalence of asthma and the demand for hospital services [2]. The critical attitude adopted towards register-based surveys has arisen partly because they provide insufficient clinical evaluation of the diseases concerned and partly because the hospital admission criteria tend to vary with time. The current approach, in which data on treatment periods and deaths among asthmatics were combined on the basis of personal identification numbers enabled needs for hospital treatment and mortality to be evaluated for the same population of asthmatics over a given interval of time, independently of changes in admission criteria, medication or disease classification.

The register of deaths contains information on all persons included in the Finnish population register at the time of death who have died in Finland or abroad. An evaluation of the reliability of the data on asthma-related deaths contained in this register, in the 1980s in relation to case history data suggested that asthma was the actual cause of death in only about half of all presumed asthma-related cases [9], while a recent investigation in Northern Ireland indicates that the sensitivity of certified asthma-related deaths is low but their specificity good, and that many COPD deaths could have been classified as asthma-related under current clinical diagnostic practices [17]. The death of an asthmatic within one month of the commencement of a treatment period is recorded as asthma-related only in one-third of cases, and research suggests that asthma is currently underdiagnosed, so that the asthma-related deaths recorded among asthmatics represent no more than the tip of the iceberg [18]. The present material includes all deaths among the asthmatics identified from the hospital discharge register. It is possible that all deaths apparently caused by asthma were caused by it, and that some of those attributed to COPD could have been asthma deaths.

A large number of asthma-related treatment periods are recorded for adult asthmatics in the early winter months and in midwinter [19], when people customarily spend more of their time indoors. This implies that the asthmatic symptoms could well be provoked by impurities in the indoor air, e.g. epithelial dust released by household pets or house mites. In addition, airway infections spread easily in winter and influenza epidemics typically occur around the turn of the year. The combination of cold outside air and physical effort, in particular, may provoke an exacerbation of asthma, as can local instances of air pollution. Other factors which may be reflected in the seasonal fluctuations in treatment periods are the summer and Christmas holidays and administrative measures such as the closure of hospital wards during the summer months. In a previous study by the author’s group, seasonal variation in hospital admissions for COPD was found to be quite similar to the variation observed in this study [20], with a peak in the number of hospitalizations in January, and a trough in June. Differing from the findings of the present study, only slight excess admissions for COPD were seen in autumn. The study included patients aged 55 yrs in the years 1972–1992. The cold weather, together with an increased incidence of respiratory infections, was supposed to be the cause of the periodicity. The seasonal pattern observed in this paper has been reported previously for older age groups [19].

Excess winter mortality, in elderly people, related to cold weather has been found in all causes of death, as well as in mortality from ischaemic heart disease, cerebrovascular disease and respiratory disease [21]. Excess winter asthma mortality has been found in elderly people, but, in younger age groups, asthma deaths have been found to peak in the summer [19, 22].
The annual variations in total mortality follow those observed in the number of treatment periods, but with a certain time-lag, so hospital treatment can be taken as indicative of the severity of asthma. This statement includes some speculation since we have not analysed the actual time-lag between the last asthma hospitalization and the death of individual previously hospitalized asthmatics and this study is a register-linkage study. Many asthmatics may be in poor physical condition when entering hospital and, thus, vulnerable to other diseases, or else the existing disease may become more severe and lead to death. Repeated treatment periods among asthmatics have been observed to be connected with a risk of asthma-related death [23]. Seasonal variations observed among adult asthmatics, in the number of treatment periods, coincide well with the pattern of death, where the highest peak and lowest trough are concerned, although with a certain time-lag. Thus, it may be concluded that a long-term assessment, based on the comprehensive national hospital register, indicates that, despite temporal fluctuations in admission criteria, asthma-related hospital treatment periods are indicative of actual treatment needs among asthmatics, the severity of asthma and the consequent risk of death.

References