Thunderstorm-associated asthma: the effect on GP consultations

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SUMMARY

Evidence shows that asthma attacks can be brought on by adverse weather conditions such as those experienced during a thunderstorm; a prime example of such an occasion being a thunderstorm episode on 24 June 1994, which resulted in a well-documented increase in medical attendances made by those suffering with asthma and respiratory disorders. However, most of these studies have concerned admissions to accident and emergency departments. The aim of this paper was to ascertain whether a similar increase in consultations was observed in the primary care setting.

Keywords: asthma; seasonal morbidity.

Introduction

THERE is evidence that thunderstorms may result in outbreaks of asthma; the thunderstorm episode in June 1994 led to a well-documented increase in attendances for asthma at accident and emergency departments in London.[1-3] We wished to determine whether a similar effect was noted in primary care. This analysis is part of a study to look at the effects of air pollution on people consulting general practitioners (GPs) with asthma and other respiratory diagnoses.

Methods

Data from 45 to 47 GP practices, covering a three-year period (1992–1994), were available for the London area from the General Practice Research Database (GPRD, formerly the VAMP database). The data were obtained from the Office for National Statistics, which manages the GPRD on behalf of the Department of Health. The GPRD consists of computerized anonymous patient records and in 1993 covered about 500 practices in the United Kingdom. Participating practices are required to record all prescriptions together with indications for all prescriptions for acute conditions and for the first of any series of repeat prescriptions. Practices have a 12-month period of training and data validation before acceptance onto the database and are required to record all significant morbidity. Over the three-year period, practices recorded the number of people consulting with asthma for each day (ICD code 493). Because of changing patient behaviour and practitioner availability, the number of consultations follow a weekly cycle, varying dramatically from weekday to weekend.

Pollution data for the period 1992–1994 were obtained from the air pollution division of AEA Technology. The pollutants considered were nitrogen dioxide and carbon monoxide (averaged over three sites around London), sulphur dioxide and black smoke (averaged over five sites), and ozone (averaged over two sites); one site provided information on PM_{10} (particulate matter of less than 10 μm diameter). In addition to the consultation and pollution data, information on 24-hour average aeroallergen levels from the National Pollen Monitoring Network, meteorological data from the Meteorological Office, and details of influenza epidemics from the Hospital Episode System (HES) data, obtained from London accident and emergency departments, were also recorded.

The daily number of patients consulting with asthma was investigated in a multivariate model in which the daily number of asthma consultations was assumed to follow a Poisson distribution.[4] The size of the practices, air temperature, humidity, pollutants, and pollen at various lags were adjusted for in the model. Long-term cycles, weekday effects, and flu epidemics were also adjusted for, and dummy variables were created for bank holidays and summer holidays. The analysis was conducted separately on children (0–14 years), adults (15–64), and the elderly (65+), and for all ages together. The possible relationship with temperature, humidity, pollution levels, and levels of various pollen types was investigated graphically prior to adjustment in the regression models.

Results

Figure 1 shows the rates per 10 000 of people consulting with asthma on consecutive Saturdays in all age groups. (Rates are presented rather than numbers to take into account the number of registered patients over the three-year period). The asthma epidemic associated with the thunderstorm episode of June 1994 manifested itself in an unusual peak in GP consultations on Saturday 25 June. The overall asthma consultation rate on this day was found to be about six times higher than the average patient consulting rate for asthma on Saturdays between 1992 and 1994; a similar effect was found in each of the separate age categories. Consultations for asthma on the Friday (the day of the thunderstorm) and the following Sunday and Monday were not unusually elevated.

Of the pollutants considered, PM_{10} was found to have been high on the 24 June, with both the daily maximum and daily average values being in the 90th percentile of the PM_{10} distribution over the three-year period; ozone levels were also within the 90th percentile for that day. No other pollutant types were found to be at unusual levels on or leading up to the day of the asthma outbreak. Of the aeroallergens considered, grass and nettle pollen levels were both found to have been extremely high on the Wednesday before the thunderstorm, with grass pollen levels being at 258 grains/m^3 (compared with a June average over the three-year period of 39) and nettle pollen levels at 89 grains/m^3 (compared with a June average of 7.8).

Multivariate models which adjusted for possible confounders were then investigated. Nettle pollen was not significantly associated with consultations for asthma but was included as part of the core model as a three-day lagged variable. Grass pollen levels, also lagged by three days, were then included in the core model and their relative risks, 95% confidence intervals, and sig-

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nificance levels for asthma consultation noted. Finally, a dummy variable for 25 June 1994 was incorporated into the model (Table 1). A repeat analysis using four-day average values (current and previous three days) of grass and nettle pollen levels instead of lagged values did not affect the results.

Discussion

For adults, children, and the all-ages group, it was found that grass pollen levels were associated with the number of people consulting with asthma but that this association was no longer statistically significant once a dummy variable for 25 June 1994

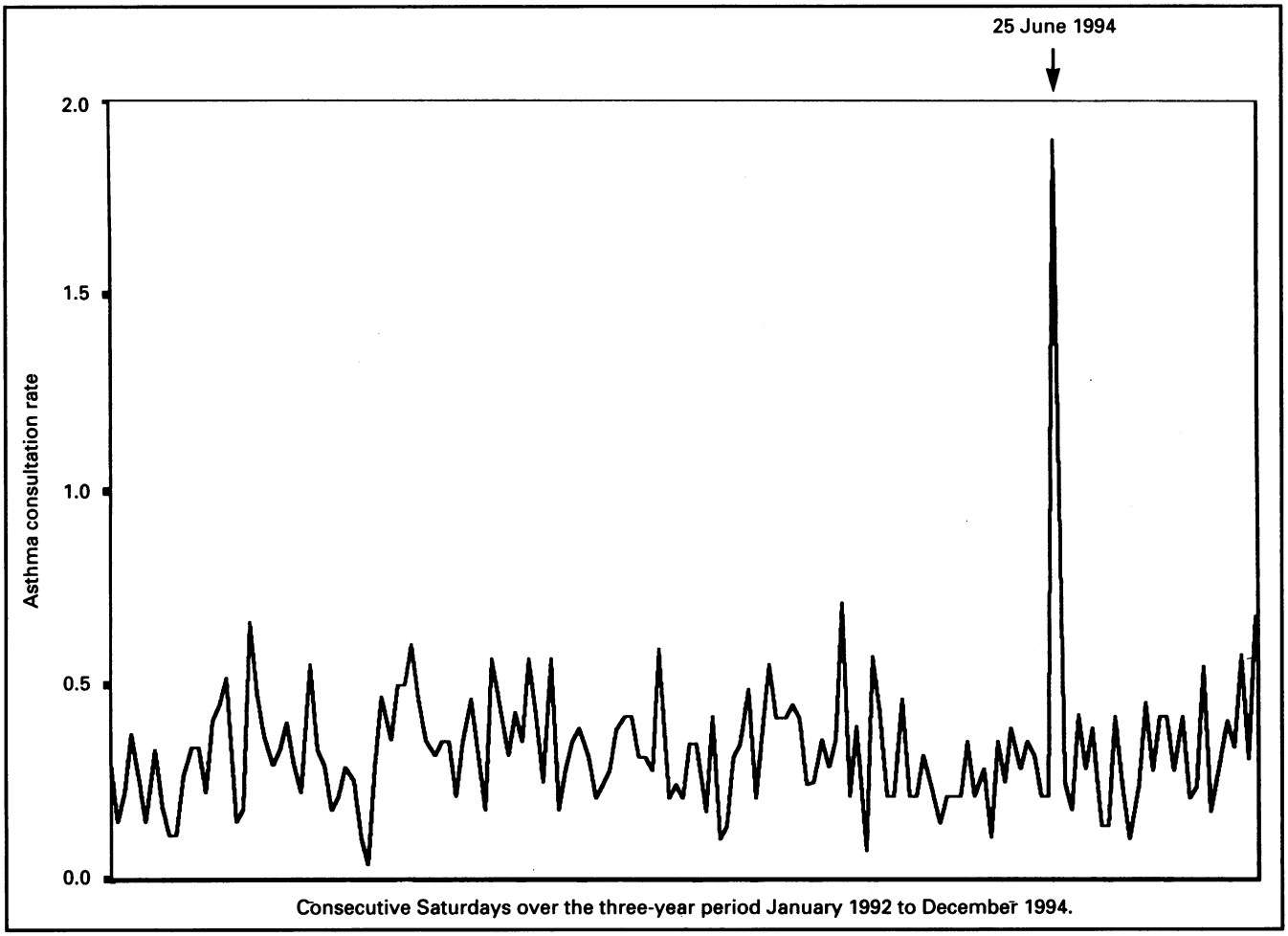

Figure 1. Rates per 10 000 patients of people consulting with asthma on consecutive Saturdays, all ages.

Table 1. Relative risks (RR), 95% confidence intervals (CI), and *P*-values for athma consultation associated with increased levels of grass pollen (100 grains/m^3 unit increase), with and without a dummy variable for the 25 June added to the core model.

Age group	Model: core +	RR	95% CI	*P*-value
All ages	Grass pollen	1.17	(1.06, 1.29)	0.0013
	Grass pollen + 25 June	1.01 6.65	(0.92, 1.11) (4.55, 9.72)	0.1637 <0.0001
Children	Grass pollen	1.21	(1.03, 1.41)	0.0257
	Grass pollen + 25 June	1.09 3.68	(0.92, 1.31) (1.84, 7.37)	0.2905 0.0002
Adults	Grass pollen	1.31	(1.16, 1.47)	<0.0001
	Grass pollen + 25 June	1.11 7.55	(0.96, 1.27) (4.60,12.41)	0.1623 <0.0001
Elderly	Grass pollen	0.81	(0.60, 1.09)	0.1507
	Grass Pollen + 25 June	0.73 10.35	(0.63, 0.85) (2.48, 43.16)	0.0439 0.0013

was incorporated into the model. There was an apparently weak protective effect of grass pollen in the elderly, but this is likely to have been spurious since it was only in evidence once 25 June was included in the model. Grass pollen levels on 22 June were the highest recorded in London for six years, and it has been suggested that asthma may have been triggered by a dramatic rise in aeroallergens resulting from gusting winds associated with the thunderstorm, or from rapid changes in humidity and rainfall.[3] However, our analysis does not suggest that the increase in consultations can be explained solely by the high pollen counts. Concentrations of allergenic fungi were not particularly high at the time, although levels of some damp air spores may have risen during and after the thunderstorm.[3] Another possible explanation for the asthma increase is that the combination of a viral agent and a sudden fall in temperature may have precipitated asthma.[5]

Earlier studies have found that people affected by thunderstorm-associated asthma are characteristically young adults[3] or children.[5] We observed a thunderstorm effect in all age groups, with the elderly group having the weakest association and a wide confidence interval. The effect of the thunderstorm episode on asthma consultations is consistent with that of other studies using different sources of data; furthermore, our data confirms that there is no evidence that air pollution was responsible for the asthma episode.[6] However, in contrast to accident and emergency data, the asthma cases on 24 June, the day of the thunderstorm, were not particularly high. This can be attributed to the fact that the thunderstorm occurred between 6 pm and 9 pm over London, by which time most practices were closed. This study reflects the experience of one GP working on a deputizing service.[7] It has been suggested that thunderstorm-associated asthma may principally affect individuals not known to have had asthma in the past;[3] this cannot be investigated in our data since those patients suffering from the first known attack of asthma could not be differentiated from those with a history of asthma.

In conclusion, our data show that the thunderstorm had a substantial effect on the number of people consulting for asthma in primary care and, in addition, confirms other research showing that data from the GPRD is useful for epidemiological studies.[8]

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