Further observations on seasonal variation. 1. Osteoarthritis

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SUMMARY. In an earlier study of morbidity in a group of inner London practices, consultations for osteoarthritis were shown to be most frequent in the late spring and late autumn months. Though this pattern agreed with the results of experiments with controlled meteorological variables, it contradicted widely-held beliefs and was not supported by the medical literature. Confirmatory evidence was therefore sought in two other sources of data. Analyses were performed on monthly figures provided by the Department of Health and Social Security of dispensed non-steroidal anti-inflammatory preparations and on five years of general practice morbidity records held by the Office of Population Censuses and Surveys. These analyses largely confirmed the earlier finding, particularly that of a spring peak for consultations for osteoarthritis, though there was some variation in the timing from year to year in both sets of data.

Introduction

IN an earlier paper[1] it was reported that consultations for osteoarthritis in general practice were most common in the late spring, especially in May, and that there was a second rise about six months later, which was not as large as the first, was more spread out and reached a maximum in November. This pattern was unexpected because it contradicted the widely-held belief that arthritis is most troublesome in the winter months and it was not supported by relevant medical literature. The seasonal variation was statistically significant and agreed with experimental evidence that the conjunction of a rising relative humidity and a falling barometric pressure exacerbate the symptoms of osteoarthritis, since the times in which these unsettled meteorological conditions are most frequent are the spring and autumn. Nevertheless reservations were expressed about the findings on four grounds: the study was based on a population of only 32 500 patients; the data came from only one year, 1980; the variation in absolute terms was not great; and the participating general practitioners had made their diagnoses without agreed criteria.

Some interesting historical evidence came to light after the paper had been published. In the eighteenth and early nineteenth centuries physicians were much taken with the relationship between diseases and the weather and in a book of that period, under the usual heading of the time 'Rheumatismus', is stated:

> 'This disease is frequent in cold and more uncommon in warm climates. It appears most frequently in autumn and spring; less frequently in winter, while the frost is constant; and very seldom during the summer. It may however occur at any season, if vicissitudes of heat and cold be for the time frequent.'[2]

The next step was therefore to look for other sets of data that were subject to fewer limitations than those of the first study, to see if they confirmed the pattern it had suggested. The number of prescriptions dispensed nationally each month for non-steroidal anti-inflammatory drugs appeared useful as did information held by the Office of Population Censuses and Surveys (OPCS) from practices which went on recording after the second national morbidity study (1970–71) was complete. The hypothesis that the months shown to be most important (April and May; September to November) would again emerge as the most important was tested on for both sets of data.

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Method

The Statistics and Research Division of the Department of Health and Social Security (DHSS) provided prescribing data for England from September 1982 to August 1983. The data were taken from a one in 200 sample of all dispensed prescriptions, covered 30 of the most commonly prescribed non-steroidal anti-inflammatory preparations and gave totals for each month of the year. The differing lengths of the months resulted in some variation, and the concept of a standard working month was used to allow for this as far as possible. The number of working days in each month was calculated by subtracting the number of Saturdays, Sundays and bank and public holidays from the total number of days in the month. The remainder was then divided into the number of prescriptions for the month, and finally the answer was multiplied by 21.1, the mean number of working days per month over the year. This gave the number of prescriptions per standard working month.

The consultation data obtained from the OPCS require some explanation. The practices began recording on 25 November 1970 and finished on 24 November 1976. Over this period some practices dropped out, always on 24 November, and new ones were recruited, always starting on 25 November. The number of patients at risk therefore varied considerably from year to year. The size of each participating practice's population was calculated by dividing the number of days for which each patient was registered in any year by the number of days in that year and totalling the fractions. The date on which any diagnosis was applied to any patient was stored only for the first occasion on which it was made while the practice was participating; after that the occurrence of the diagnosis was stored, but not the date on which it was made. With chronic illnesses that give rise to repeated consultations it is thus inevitable that the only date available will tend to come earlier rather than later in the recording period. The first year will be particularly affected, and in this case the effect would be increased because the population was then at its greatest. To reduce the resulting bias the data for 1970–71 have therefore been omitted from the analysis of monthly distribution. The 1971–76 data used cover the following patients:

1. Patients in practices recording from 1970, first diagnosed after November 1971.
2. Patients in practices recording from 1970, first diagnosed before November 1970 but not consulting about osteoarthritis in the recording period until after November 1971.
3. Patients joining a recording practice after November 1971 with established osteoarthritis, and entered at their first consultation for the condition.
4. Patients in practices which began recording after November 1971, who were entered at their first consultation for the condition.

The number of first consultations in each of the 60 months covered was noted and then converted into the number per standard working month.

A diagnosis of osteoarthritis implies only that the general practitioner recorded a condition coded under the heading 'Osteoarthritis' (code 713.0) in the eighth revision of the *International classification of diseases* which was current at that time.[3]

Appendix 1 shows the methods employed in analysing for seasonal variation the one year of prescribing data and the five years of first consultation data where the population differed each year.

Results

The spring peak

Figure 1 shows that in the year September 1982 to August 1983 most prescriptions for non-steroidal anti-inflammatory preparations were dispensed in April. An analysis of deviance (Appendix 1, Table 1) revealed that the number of such prescriptions in April and May was very high when these months were compared with the other 10 ($P<0.001$).

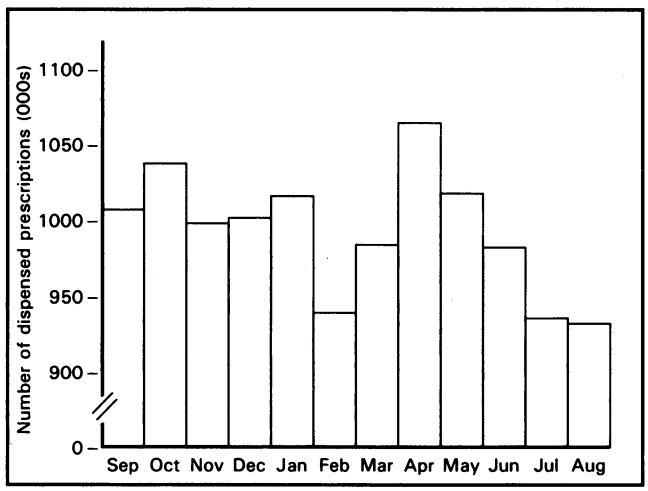

Figure 1. *Number of dispensed prescriptions (thousands) for non-steroidal anti-inflammatory preparations per standard working month over the period September 1982 to August 1983 (England, DHSS estimates).*

Figure 2 shows the distribution of first consultations for osteoarthritis in the OPCS recording practices over the period 1971–76 for a 'year' which consists of combined data for five standard working Decembers and so on. Since first consultations tend to come earlier rather than later in a recording period, random distribution would produce a decrease from the first month to the last, though it cannot be plotted because of changes

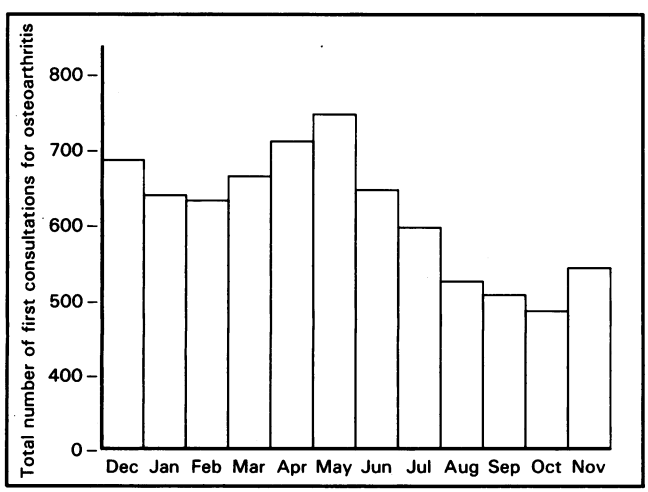

Figure 2. *Total number of first consultations for osteoarthritis in OPCS recording practices per standard working month for the period 1971–76.*

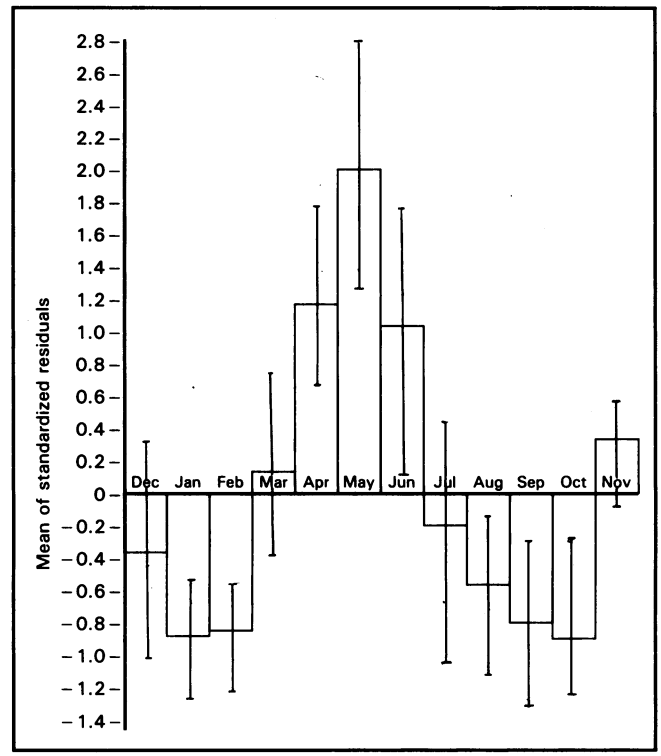

Figure 3. *First consultations for osteoarthritis: means and standard errors of standardized residuals after linear modelling for the standard working months.*

in the practices and patient population each December. Two deviations from this steady decrease can be seen. One starts in March and reaches a maximum in May; the other occurs in November. The resulting pattern is more clearly visible in Figure 3, which shows the excess consultations in the two peaks after linear modelling (see Appendix 1). The spring peak was very pronounced, and the analysis of deviance (Appendix 1, Table 4) showed that first consultations were significantly more common in April and May than in the remaining 10 months ($P<0.001$).

Thus both the prescribing data and the consultation data not only confirm the existence of a spring peak but also support the research hypothesis that April and May are the months when osteoarthritis is significantly more common.

The autumn peak

Figure 1 shows an autumn peak in prescriptions for non-steroidal anti-inflammatory preparations in October 1982. To remove the effect of the larger spring peak, the research hypothesis that September to November will have a significantly increased number of prescriptions was tested only in the autumn and winter months, September to February. The analysis of deviance (Appendix 1, Table 1) supported the hypothesis and showed a significant increase ($P<0.05$); when October was considered on its own the increase was more highly significant ($P<0.01$).

The autumn peak in first consultations (Figures 2 and 3) was small. The analysis of deviance of standardized residuals (Appendix 1, Table 4) showed no significant excess for September to November compared with December to February; the number for November alone, however, was significantly raised ($P<0.05$) when this month was compared with the other five.

There is thus some evidence for a second peak in prescriptions and consultations from September to November which is probably least likely in September. This peak is, however, supported less strongly by the data than the first peak in April and May.

Discussion

The present results support the seasonal pattern in consultations for osteoarthritis suggested by the earlier findings, particularly the surprising peak in April and May.

Discrepancies between the prescribing data and combined consultation data are small compared with those between the individual years of the consultation data (Appendix 1, Table 2). Whatever lies behind the general pattern, it appears to vary from year to year. The suspicion that the unknown factor is connected with the weather therefore remains strong, though what it is and how it exerts its effects on the body are as much of a mystery as ever.

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Appendix 1

Prescribing data

The estimated monthly figures for 30 commonly dispensed non-steroidal anti-inflammatory preparations were converted into totals per standard working month. Taking the distribution to be approximately Poisson, an analysis of deviance was performed and the results are shown in Table 1.

Consultation data

The monthly figures for first consultations for osteoarthritis in the OPCS recording practices from December 1971 to November 1976 were converted into totals per standard working month and their distribution is shown in Table 2. Inspection of the patterns for individual years shows that the highest figure does not always come in either April or May. Yearly variation in the populations is also shown.

The use of first consultations produces a biased monthly trend which must be removed as far as possible before an attempt is made to look for a genuine seasonal trend within the data. The technique of linear modelling was used for this purpose,[4] with the assumption that the consultations have a Poisson distribution. The model: E (consultations per standard working month in year Y, month T) = exp (T, α Y) — that is the log of the number of consultations was linear in months for each separate year — was fitted by GLIM.[5] The effects of fitting the various parameters of the model are shown in Table 3. It can be seen that there was a statistically strong effect both for year and for month within year, but since it did not fit exactly the standardized residuals were inspected and revealed a rise around April and May and a lesser second rise in November and December. The results of the analysis of deviance of the standardized residuals are shown in Table 4.

Table 1. Dispensed non-steroidal anti-inflammatory drug prescriptions: analysis of deviance (Poisson model, log link).

Months	Deviance	df	
Sept–August	99.28	11	
April/May vs rest of year	69.33	10	$P<0.001$
Sept–Feb	27.62	5	
Sept–Nov vs Dec–Feb	21.11	4	$P<0.025$
Oct vs rest of Sept–Feb	19.06	4	$P<0.01$

df = degrees of freedom.

Table 3. First consultations for osteoarthritis in OPCS recording practices, December 1971–November 1976: analysis of deviance (Poisson model, log link).

	Deviance	df	
Grand mean only	2836.0	59	
Constant for each year	190.7	55	$P<0.001$
+ slope over months within year	130.3	54	$P<0.001$
+ different slope over months within each year	117.2	50	$P<0.05$

	Estimates	SE
Grand mean	5.874	0.035
less: 1972–73	−0.993	0.065
1973–74	−1.387	0.075
1974–75	−1.423	0.078
1975–76	−1.573	0.082
Slope for 1971–72	−0.037	0.005
1972–73	−0.014	0.008
1973–74	−0.006	0.009
1974–75	−0.031	0.009
1975–76	−0.019	0.010

df = degree of freedom. SE = standard error.

Table 4. First consultations for osteoarthritis in OPCS recording practices, December 1971–November 1976: analysis of deviance of standardized residuals after linear modelling (normal model, identity link).

	Deviance	df[a]	
Grand mean	119.10	50	
April/May vs rest of year	89.54	49	$P<0.001$
Sept–Feb	29.64	25	
Sept–Nov vs Dec–Feb	29.24	24	NS
Nov vs rest of Sept–Feb	25.03	24	$P<0.05$

[a] Degrees of freedom are down since parameters have already been fitted to produce these residuals. NS = not significant.

Table 2. Number of first consultations for osteoarthritis in OPCS recording practices in standard working months from December 1971 to November 1976.

Standard working month	Number of first consultations for osteoarthritis					Total
	1971–72 (n = 256 675)	1972–73 (n = 124 325)	1973–74 (n = 102 679)	1974–75 (n = 105 664)	1975–76 (n = 103 767)	
December	327.6	112.2	72.2	98.1	77.4	687.5
January	294.3	113.2	87.3	81.5	61.3	637.6
February	299.4	129.8	74.9	61.2	66.5	631.8
March	316.5	137.2	94.4	57.7	69.7	675.5
April	336.5	143.3	92.8	78.6	67.5	718.7
May	347.2	124.7	104.5	76.4	91.8	744.6
June	259.9	134.6	113.9	86.4	56.6	651.4
July	292.4	117.0	67.9	70.6	51.8	599.7
August	230.2	100.7	94.4	57.0	61.3	543.6
September	231.1	125.5	65.3	49.9	56.6	528.4
October	208.1	98.2	73.4	61.5	56.3	497.5
November	227.3	105.5	81.4	66.5	66.8	547.5

n = patient population.