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Time changes in new cases of ischaemic heart disease in general practice

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Background. There are no recent studies of the presentation of ischaemic heart disease (IHD) in general practice. What information exists is derived from the secondary care setting, where seasonal and daily variation has been reported in admissions for IHD. There are epidemiological studies that show a falling incidence and mortality for IHD. It is not clear, however, if this is also the case in clinical general practice.

Objectives. The aims of the present study were to (i) estimate the number of cases of IHD in general practice populations; (ii) determine the recorded diagnosis and time of first presentation of IHD during a 5 year period; and (iii) perform time series analysis on the above data.

Methods. The design of the study was a retrospective survey, using MIQUEST software, of computer databases in five general practices with a combined population of nearly 40 000 patients. The five practices were selected randomly from volunteering practices in the Trent Focus Collaborative Research Network. All patients with a new diagnosis of IHD recorded between January 1993 and December 1997 inclusive were included in the study. The number of new cases of IHD, the recorded diagnosis and time of first presentation of IHD were the main outcome measures.

Results. A total of 644 new cases of IHD were identified during the study period: 54.0% ‘angina pectoris’, 26.9% ‘acute myocardial infarction’, 18.8% ‘ischaemic heart disease’, 0.3% ‘coronary atherosclerosis’. Time series analysis reveals a seasonal and weekly pattern to new cases of IHD, with peak cases occurring in January and on Mondays/Fridays. A downward trend was detected for new cases of IHD (all diagnoses) over the 5 year period, and for new cases of IHD (excluding acute myocardial infarction). An upward trend was observed for new cases of acute myocardial infarction.

Conclusion. Presentation of IHD in general practice varies according to season and day of the week. The proportion of new cases recorded as ‘angina pectoris’ or ‘ischaemic heart disease’ is falling, and this decline masks a rise in the incidence recordings of ‘acute myocardial infarction’.

Keywords. Ischaemic heart disease, MIQUEST, seasonal, time series analysis, trend.

Introduction

Most patients with angina pectoris initially present to their GP, but less than one-fifth of these are referred for hospital investigation;[1] therefore, studies of ischaemic heart disease (IHD) that are based on secondary care data may not be an accurate reflection of the disease in the general population.

There have been few studies describing presentation or prognosis of IHD in the general population or in general practice in the UK. The Whitehall Study[2] of 1967–1969 involved cardiorespiratory screening of >18 000 male civil servants. In another study,[3] 268 patients with angina from a single general practice were followed up between 1950 and 1975, but data of this age must be interpreted with caution because the mortality from IHD has since

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declined, and there is evidence that the incidence of IHD is also lower.[4]

In 1976, the prognosis of angina pectoris was investigated by asking GPs to refer patients with new or suspected diagnoses of IHD to a hospital clinic.[5] Although this study drew its sample population from general practice, the follow-up of the patients took place elsewhere, so the outcomes for this group of patients may not be the same as if some of them had remained solely within the general practice setting.

The prevalence of angina pectoris in general practice was estimated by survey[6] in 1982, but the study relied on the notification of cases by GPs, and no information about the complications of angina was recorded. In 1995, the incidence of new cases of angina pectoris in the UK was estimated at 22 600 patients per annum,[7] with one in 10 of these developing further complications of non-fatal myocardial infarction or coronary death within 1 year of the initial diagnosis, but again this study relied upon patients from general practice being followed up in a hospital clinic.

The National Morbidity Studies in General Practice provide data on the prevalence and incidence of IHD, but not on the time of presentation. There remain, therefore, no published contemporary data on the presentation of IHD in general practice. However, the advent of computerized records in general practice offers new potential for investigation. Many mutually incompatible computer systems exist in general practice, and this has proved to be an obstacle in the way of data access. Morbidity Information Query and Export Syntax (MIQUEST) software[8] has been developed to facilitate access to consistent, anonymized data from a variety of general practice computer systems. MIQUEST is beginning to find use for local and national data collection schemes such as the Collection of Health Data in General Practice (CHDGP).

The objectives of the present study were to (i) estimate the number of cases of IHD in general practice populations; (ii) determine the recorded diagnosis and time of first presentation of IHD during a 5 year period; and (iii) perform time series analysis on the above data. A retrospective survey of computer databases in five general practices using MIQUEST was carried out.

Methods

Practice selection

An outline study protocol was sent to all practices in the Trent Focus Collaborative Research Network that were able to run MIQUEST software on their computerized databases: this limited the study to practices using EMIS and Meditel computer systems, and all used the Read coding schemes for recording morbidity. Of those practices that expressed an interest, five were selected at random by drawing lots. The study protocol was approved by the local Research and Ethics Committee.

Patient selection

All patients who were newly diagnosed with IHD in the 5 year period January 1993 to December 1997 inclusive were included in the study.

Validation of the databases

Validation was undertaken prior to data collection, and consisted of a comparison of the data held on the computer databases with similar external and internal data. For the validation against external data, the percentage of the total practice population with angina pectoris (new and old cases) was compared with similar national data from the CHDGP project: the CHDGP also uses MIQUEST to extract its data. For the internal validation, a 10% sample of computer-recorded diagnoses of angina pectoris was checked against the corresponding manual records.

Data extraction

MIQUEST software was used to extract the data for the validation and for the main study. For each new case of IHD between January 1993 and December 1997, the first recorded diagnosis of IHD was noted, along with the date on which the diagnosis was recorded. Any patient with IHD diagnosed before the 5 year period was excluded for the main part of the study. This gave a population of new cases of IHD from which to calculate incidence, and look for patterns in the time of presentation.

Time series analysis

Subtotals of the numbers of new cases of IHD were calculated at monthly intervals for the 5 year period. The total number of new cases occurring in each month, and for each day of the week were calculated along with 95% confidence intervals derived from the Poisson distribution, and tests of heterogeneity applied.[9–11] Where significant seasonal patterns were observed, further analysis of the 60 consecutive monthly totals was undertaken according to the methods described by Chatfield,[12] using Minitab statistical software. Briefly, this analysis consisted of a plot of the monthly totals against time, followed by the fitting of a time series model with trend and seasonal components. The trend component was identified using the least squares method, and the seasonal component (having a period of 12 months) identified from the monthly analysis. Trend and seasonal components were multiplicative in the fitted models. The adequacy of fit for the models was assessed in a two-stage approach. First the residuals were checked for autocorrelation. In an autocorrelation analysis, autocorrelation coefficients are statistically significant at the 5% level if they exceed $\pm 2/\sqrt{N}$, where N is the number of observations in the time series. For an adequate model fit, no statistically significant autocorrelation coefficients should be detected in the residuals. Secondly, the fitted values and the original data were checked for association by simple linear regression and analysis of variance.[13]

Results

Validation of the databases

For the validation against external data, the prevalence of angina pectoris from the national CHDGP in 1998 was 1.97 ± 0.35% (95% CI), and in this study the prevalence of angina pectoris was 2.25%. For internal validation, all corresponding manual records identified from the computer records contained a recording of IHD.

New cases of IHD and diagnoses

The incidence of IHD as recorded on the computer databases was found to be 644 new cases over 5 years in a population (all ages) of 39 388 (0.3% per year). Of the 644 new cases, 348 (54.0%) were recorded as 'angina pectoris', 173 (26.9%) as 'acute myocardial infarction', 121 (18.8%) as 'ischaemic heart disease' and two (0.3%) as 'coronary atherosclerosis'.

Age–sex profile

Of the 644 new cases, 355 were male and 289 were female. The mean age of the males was 61.3 years (SD 11.8 years). The mean age of the females was 67.3 years (SD 11.7 years). This age difference between males and females was statistically significant ($t = -6.43$, $P < 0.0001$).

Gender differences in diagnosis at first presentation

Table 1 shows a significantly higher number of males with a recorded diagnosis of acute myocardial infarction at first presentation (chi-squared = 16.369, $P < 0.0001$).

Time series analysis

Trend and seasonal analysis. These results are illustrated in Figure 1. Residuals from the fitted model were found to be free from significant autocorrelation, and linear regression of the fits on the actual data was statistically significant with an R^2 value of 69.8%. The 12 monthly seasonal variation is clearly seen, with an excess of IHD recorded in January. This may have been because cases occurring over Christmas were not recorded until January, so in Figure 2 the same data are analysed in 2 monthly intervals, combining December and January figures: the seasonal pattern remains.

TABLE 1 *Gender differences in recorded diagnosis at first presentation (percentages of 644)*

	Male	Female	Total
Acute myocardial infarction	118 (18.3%)	55 (8.5%)	173
Other ischaemic heart disease	237 (36.8%)	234 (36.3%)	473
Total	355	289	644

In Figure 1, the trend component of the model shows a decrease in the number of new cases of IHD observed during the study period.

Figure 3 shows the data for new cases analysed by diagnosis. The trend component is upward for myocardial infarction, but downward for other diagnoses of IHD, suggesting that the downward trend observed in Figure 1 may be attributed in part to a decrease in new cases of IHD that are not myocardial infarction.

The downward trend in new cases was investigated further according to age and sex. A downward trend in new cases of IHD was observed in females over 60 and males under 60 years. A slight upward trend was observed in males over 60. There was no statistically significant variation in the data for females under 60.

Day of the week. Figure 4 shows variation in the number of new cases of IHD according to the day of the week. Monday and Friday are associated with more cases, and Saturday and Sunday fewer cases than Tuesday, Wednesday and Thursday. The pattern is less pronounced for diagnoses of myocardial infarction, however.

Discussion

Limitations of the study

In a study such as this where computer databases are the only source of data, the quality of the data in terms of completeness and accuracy can limit the conclusions that can be drawn. The validation steps that were taken suggest, however, that the databases were internally consistent with the manual records for angina pectoris, and that the prevalence of angina pectoris as recorded on the computer databases is consistent with national figures derived from MIQUEST searches of computer databases. The seasonality and weekly patterns are similar to those observed in hospital admissions for IHD. Taken together, these observations suggest that the data are of sufficient quality to allow conclusions to be drawn about time of presentation of IHD. Identification of trends in the data requires more caution, however. The downward trend may be a recording artefact: computer databases were still quite new in 1993, and data from before 1993 may have been transferred from the manual records to computer at this time, resulting in the actual date of diagnosis being masked by the date of entry on the computer, thus giving an artificially high number of new cases of IHD during the early part of the study period. A recording artefact may also explain some of the weekday variation: weekend data may not be entered into the computer until Monday, giving an artificially high value for Monday. These artefacts do not, however,

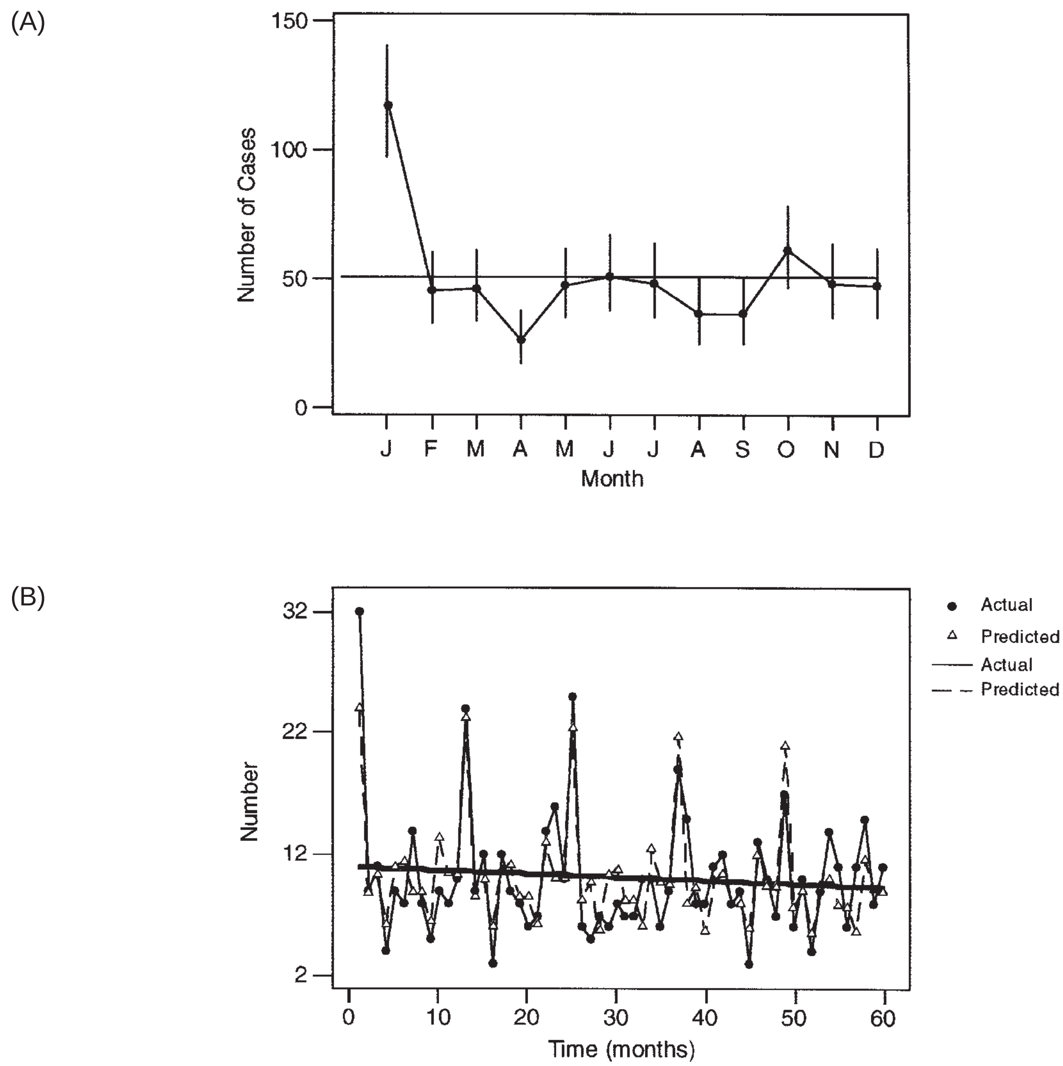


FIGURE 1 *(A) New cases of IHD by month, with mean and 95% confidence intervals. Test for heterogeneity: chi-squared = 111.3, 11 df, P < 0.001. (B) Trend and seasonal model for all new cases of IHD over 5 years. Coeffeicient of determination, R^2 = 69.8%, F = 134.0, P < 0.0005*

explain the Friday peak in the data, nor the seasonal pattern. Trends may also be difficult to interpret without reference to the stability of the population over time, but obtaining such information would require past practice populations to be generated for each point in time, and this is beyond the scope of the data extraction methods used here. Therefore, in spite of potential limitations, there are patterns in the data that require further consideration.

Discussion of findings

Seasonal variation in IHD is well described in hospital settings,[11,14–17] but not in general practice. This study confirms that the pattern observed in hospitals is a reflection of that seen in general practice. The high number of new cases recorded in January in this study could have been due to cases over the Christmas/New Year holiday

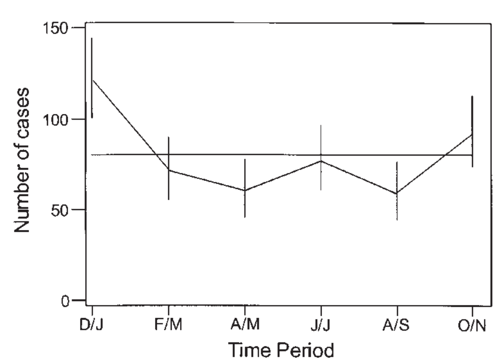


FIGURE 2 *New cases of IHD grouped in 2 month intervals, with mean and 95% confidence intervals. Test for heterogeneity: chi-squared = 34.45, 5 df, P < 0.001*

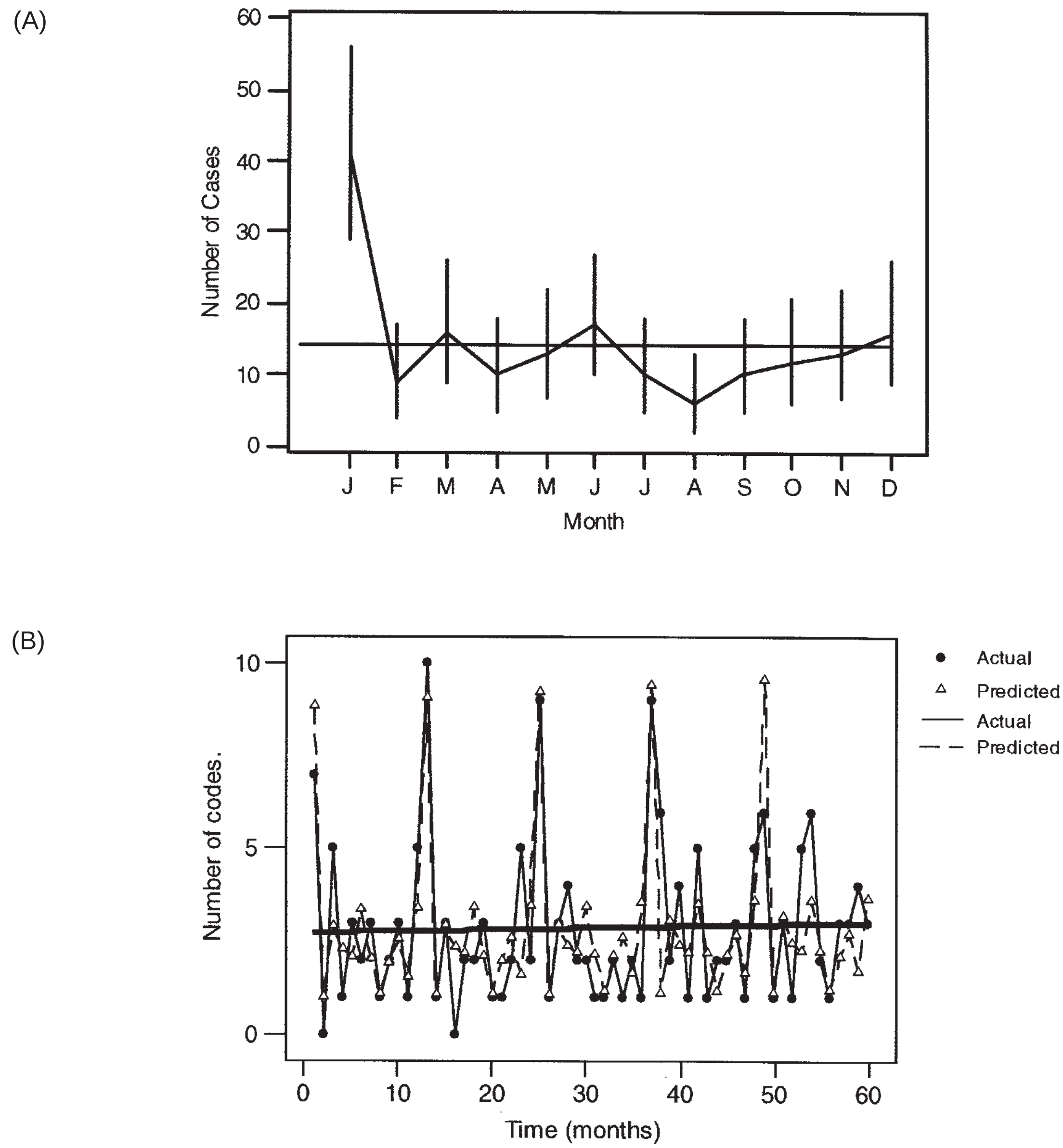
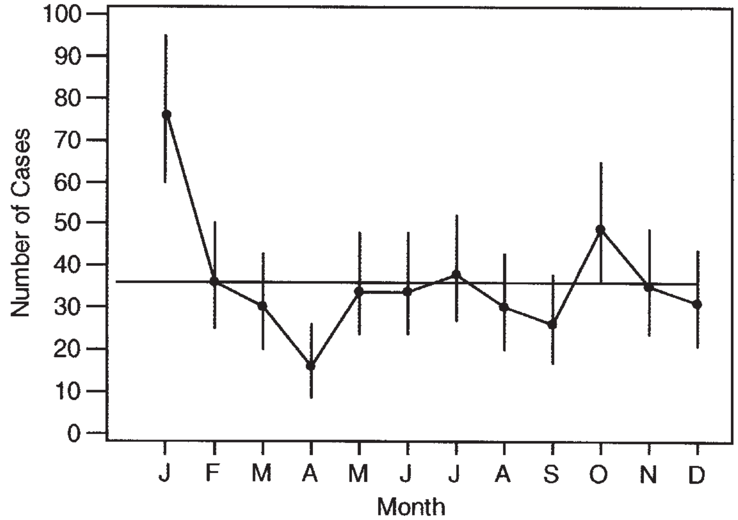


FIGURE 3 *(A) New cases of IHD where the first diagnosis of IHD was myocardial infarction, by month, with mean and 95% confidence intervals. Test for heterogeneity: chi-squared = 61.5, 11 df, $P < 0.001$. (B) Trend and seasonal analysis where the first diagnosis of IHD was myocardial infarction. Coefficient of determination, $R^2 = 58.8\%$, $F = 82.84$, $P < 0.0005$.*

not being recorded until January. In Figure 2, the seasonal pattern is still present even when figures for December and January are combined; therefore, it is likely that this seasonal pattern in genuine. It has been suggested[11] that seasonal and circadian rhythms in IHD are driven by common mechanisms, and that the autonomic nervous system may be involved: high levels of sympathetic nervous system activity are associated with coronary events, and any factor known to trigger such activity, e.g. exposure to cold, may increase the risk of a coronary event.

The weekday pattern of cases of IHD is similar to that observed in hospital admissions for IHD,[11,16] but Figure 4 shows a further peak on Friday. It was noted in Figure 4 that the variation in diagnoses of acute myocardial infarction shows a similar, although less pronounced pattern. Taken together with the hospital admission data,[11,16] the data from the present study suggest that there is a genuine variation in the presentation of IHD according to the day of the week. The Monday peak may be an artefact of recording, but is consistent with the hospital data. A Friday peak is not consistent with the hospital data and might reflect a different pattern in IHD presentation in general practice. Perhaps patients consult on Friday because they do not want to 'leave it until next week', and therefore seek reassurance. This, of itself,

(C)



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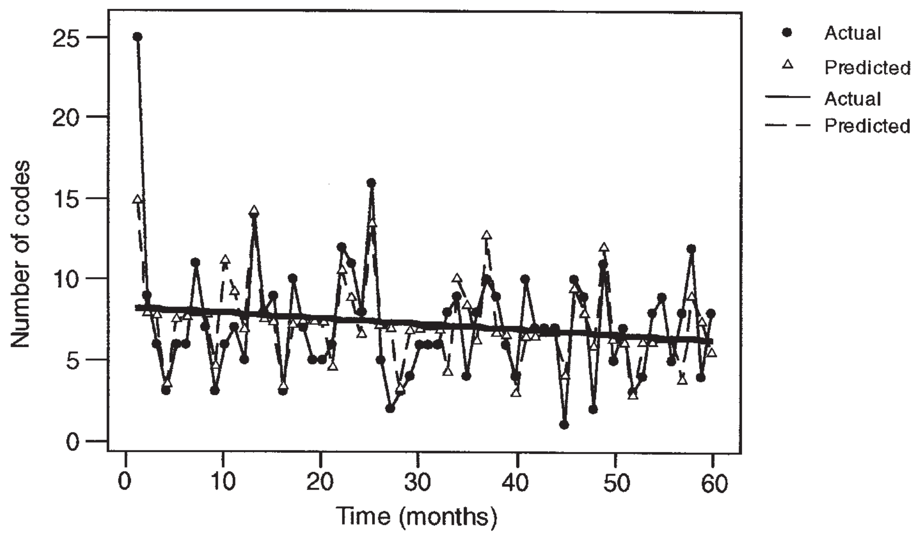

FIGURE 3 *(C) New cases of IHD where the first diagnosis of IHD was not myocardial infarction, by month, with mean and 95% confidence intervals. Test for heterogeneity: chi-squared = 65.6, 11 df, $P < 0.001$. (D) Trend and seasonal model for all new cases of IHD that were not myocardial infarction. Coefficient of determination, $R^2 = 54.1\%$, $F = 68.38$, $P < 0.0005$*

would not explain why a diagnosis of IHD is recorded by the GP, and the literature offers no physiological explanation for a Friday peak in cases of IHD. It has been suggested[11,15,16] that Monday peaks in hospital data for IHD might be associated with lower levels of stress at the weekend and higher levels on Monday, in both working and retired patients.

The trend component of the time series model in Figure 1 suggests that the number of new cases of IHD declined between 1993 and 1997. Provided it is not an artefact, this observation may represent changes in the natural history of the disease. If the trend is genuine, the data also suggest that the decrease in the number of new cases is present in female patients over 60 and in men under 60, but men over 60 show a rising trend. Furthermore, the trend in new cases is downward for diagnoses other than myocardial infarction, but upward for new cases of myocardial infarction. If it is the case that the downward trend in IHD (all diagnoses) is masking an upward trend in acute myocardial infarction, then this could be an important new observation about IHD. It suggests that myocardial infarction might represent a disease process that has been unaffected by whatever factors may be driving the downward trend in less acute presentations of IHD. Alternatively, those people who present with myocardial infarction may have a different

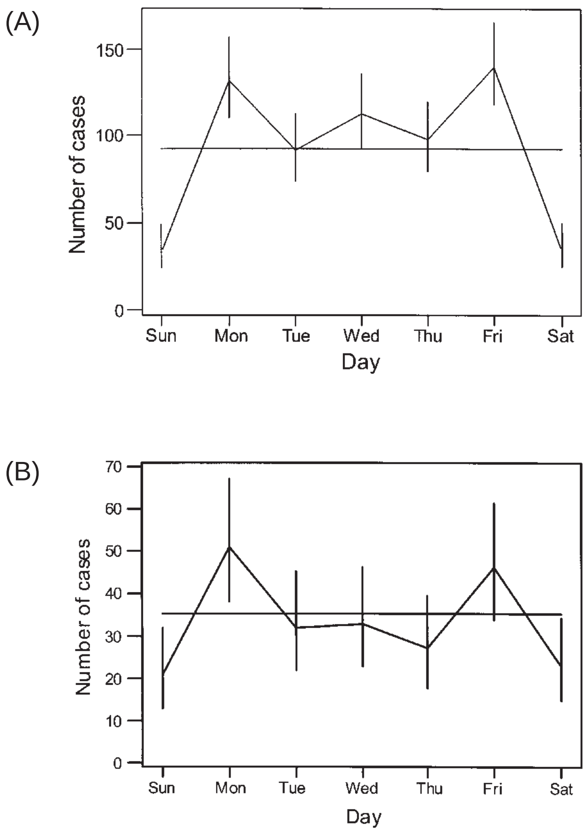

FIGURE 4 *(A) All new cases of IHD, by day of the week, with mean and 95% confidence intervals. Test for heterogeneity: chi-squared = 116.7, 6 df, P < 0.001. (B) All instances of myocardial infarction, by day of the week, with mean and 95% confidence intervals. Test for heterogeneity: chi-squared = 23.2, 6 df, P < 0.001*

lifestyle or risk factors than people who present with other diagnoses of IHD. Further investigation of these trends will require longer time series of data from a larger and more geographically widespread group of practices.

Summary

Time series analysis has confirmed the findings from hospital-based data of winter seasonality and a weekday variation in presentation of IHD. We have observed a peak in the number of new cases of IHD on Friday that is not observed in the hospital data. A falling trend in new cases of IHD (all diagnoses) was observed, but this appears to be masking an upward trend in new cases of IHD presenting as acute myocardial infarction.

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