Short reports

Gender differences in seasonality of acute myocardial infarction admissions and mortality in a population-based study

V Grech, O Aquilina, J Pace

Acute myocardial infarction (AMI) causes significant morbidity and mortality, and accounts for a substantial proportion of healthcare appropriation. Several studies have shown a seasonal variation in onset and mortality from AMI. Such variations are important not only for epidemiological purposes, but also for efficient allocation of healthcare resources.

Methods

We retrospectively analysed seasonal variation for all hospital admissions (and mortality thereof) with AMI in Malta for the period 1994-1998. We also correlated AMI admission and mortality with ambient temperatures. The catchment area for this study was Malta, an island in the centre of the Mediterranean (population 470 000), with one regional hospital (St Luke's). Potential limitations in this study were minimal as all deaths without a known cause must, by law, undergo postmortem examination. Biases, if any, in diagnosis reporting, timing of AMI events and quality of clinical records, should be the same for both sexes and at all times of the year.

Age standardised rates were calculated from the World standard population (direct method) with Poisson derivation of 95% confidence intervals (CI). Seasonal analysis was carried out by Edward's method, which fits a harmonic curve to the data by mathematically arranging monthly data in an imaginary circle that represents the annual cycle. The distance from the centre of the circle from which each month is plotted is a function of the value under study for each month. The centre of gravity of the circle, as affected by the weighting for the individual months, is then computed with the direction from the centre of the circle representing the time of the peak of the occurrence, and the distance from the centre representing the intensity of seasonal peak. The final results of Edward's technique are the angle representing the peak period in degrees (table 1), and the significance level as a χ^2 statistic with two degrees of freedom.

t Tests assuming unequal variances were used to compare differences in ages at admission with AMI and at death of AMI admission. The possible association of ambient temperatures with AMI admission or mortality was tested with two tailed Spearman rank correlation (SPSS). The χ^2 for trend was calculated with Statcalc (EpiInfo). A *p* value ≤ 0.05 was taken to represent a statistically significant result.

Results

A total of 2157 patients were admitted with AMI over 1994-1998 (1395 men, 762 women; M:F 1.8:1). Mean age for AMI admission for men and for women were 62.4 and 71.6 years respectively ($t=18$, $p<0.0001$). Patients were subdivided into four groups: <60, 60-69, 70-79 and >79 years. The male to female ratio decreased significantly along these groups, at 6.6, 2.1, 1.1 and 0.6 respectively (χ^2 for trend=288, $p<0.0001$). There were 212 deaths from 2157 AMI admissions, a hospital mortality of 9.8%, with 108 men and 104 women (mortalities of 13.6 and 7.7% respectively). Mortality was significantly higher in women (OR=1.53, 95% CI 1.15 to 2.04; $\chi^2=8.6$, $p=0.003$). Mean ages for deaths of AMI for men and for women were 70.1 and 76.8 years respectively ($t=5.2$ $p<0.0001$).

Crude admission rates (per 100 000 population) for men, women and overall were 606, 432 and 618 respectively. The equivalent age adjusted rates were 642 (95% CI: 607 to 676), 247 (95% CI: 229 to 266) and 434 (95% CI: 415 to 452). For AMI admission deaths, crude rates for men, women and overall were 62, 59 and 61 respectively. The equivalent age adjusted rates were 47 (95% CI: 38 to 56), 29 (95% CI: 24 to 35) and 37 (95% CI: 32 to 43).

A highly significant seasonal variation was found for AMI admissions ($\theta=37^\circ$, Feb table 1, $p<0.0001$, fig 1), with a peak in January and a trough in June to July. The main contribution was female despite the smaller number of

Paediatric
Department, St Luke's
Hospital,
Guardamangia, Malta
V Grech

Cardiology
Department, St Luke's
Hospital
O Aquilina

Department of Health
Information,
Guardamangia, Malta
J Pace

Correspondence to:
Dr Grech (victor.e.grech@
magnet.mt)

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Table 1 Months expressed as degrees on an imaginary circle using Edward's method

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
15	45	75	105	135	165	195	225	255	285	315	345

Figure 1 Percentage variation in admission with myocardial infarction for all patients, stratified by gender.

female admissions ($\theta=37^\circ$, $p<0.0001$), with little male contribution ($\theta=38^\circ$, Feb, $p=0.076$). The first quarter peak in admissions was consistent for all ages except for the under 60 years age group ($\theta=37-47^\circ$, Feb, $p\leq 0.006$). Seasonal variation was produced by women at almost all age groups, with no significant male seasonal variation at any age group. Mortality overall showed a peak in January ($\theta=1$, $p=0.001$), entirely caused by female variation ($\theta=25$, $p<0.0001$).

The mean monthly minimum and maximum temperatures were 9.3°C and 33.9°C respectively. Ranked mean monthly ambient temperatures correlated highly with monthly admissions ($r=-0.44$, $p<0.0001$). Female admissions were more highly correlated ($r=-0.54$, $p<0.0001$) than were male admissions ($r=-0.19$, $p=0.16$). Monthly mortality of AMI admissions also correlated with mean monthly ambient temperatures ($r=-0.33$, $p=0.009$). Again, this correlation was far stronger for women ($r=0.42$, $p=0.001$) than for men ($r=0.10$, $p=0.45$).

Discussion

An increase in winter AMI has been reported¹ as well as increased winter mortality ranging between 22% to 53% in Hawaii, New Zealand, Scotland, China and the United States.²⁻⁴ A direct effect between the extent of temperature decrease and mortality has been noted.⁵ Conversely, seasonal variation in Taiwan (with less temperature fluctuations) was not found.⁶ To the best of our knowledge, ours is the first study that demonstrates gender specificity in

seasonal variability in AMI admissions and mortality. This was not found by Spencer *et al* on specific subgroup analysis of a large AMI cohort, by age and gender.³

We speculate that low winter temperatures may be more likely to trigger AMI in older patients,⁷ and as women tend to present with AMI at a later age than men, women will therefore tend to exhibit a more marked seasonal variation. A later age at presentation with AMI will also lead to increased mortality of AMI, with a resulting seasonal variation. However, men did not show any significant seasonal variation at any age group, and we therefore cannot exclude the involvement of other gender specific factors.

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