Chest pain in women: a study of prevalence and mortality follow up in South Wales

M J CAMPBELL,¹ P C ELWOOD,² S ABBAS,³ AND W E WATERS¹

From Community Medicine,¹ Southampton General Hospital, Southampton SO9 4XY, MRC Epidemiology Unit (S Wales),² Cardiff, UK, and University Mains,³ Malaysia

SUMMARY The London School of Hygiene cardiovascular questionnaire was administered by interviewers in a community survey of 1428 women aged 45–74 living in the Rhondda Fach in south Wales. The results were analysed after a 12 year follow up for mortality. The prevalence of angina was similar to that of a Swiss population, where the method of administration of the questionnaire was similar. The risk of dying associated with angina was some 50% higher than that for women without angina, significant at the 5% level. The risk was greatest for women aged 45–54 when angina accounted for some 15% of deaths in the follow up period. Grade 2 angina was associated with a higher mortality from coronary heart disease, with more than double the risk. The overall risk of dying associated with angina did not appear to decline with time.

The London School of Hygiene cardiovascular questionnaire^{1,2} has been widely used as a screening device for angina pectoris and myocardial infarction.^{3–11} It has been mainly used to study male populations, although several studies have also included women.^{4,9–11} The purpose of this paper is to report the prevalence of angina in a community survey of women living in the Rhondda Fach in south Wales and to examine the mortality in relation to angina in a 12 year follow up study, allowing for age and smoking effects.

Methods

All women aged between 20 and 74 living in a defined area of the Rhondda valley in south Wales in 1967 were invited to attend a survey that was mainly haematological. The response rate was over 86%. The over 65 age group were not studied in part of the valley. A number of trained observers administered a version of the London School of Hygiene cardiovascular questionnaire.^{1,2} The results of the cross sectional study, in relation to sucrose consumption, have been reported previously.⁷ The women were followed up in 1979 by home visiting. Survival was assumed only if the subject, or a close relative, was interviewed or if a letter was received from the subject. For every death up to the end of 1978 a certified copy of the death certificate was inspected and the cause classified by the

International Classification of Diseases (8th revision). Follow up was 99.9%.

Mortality was low for younger women and so we only present the results of the women over 45. Statistical methods have been described by Campbell,¹² and were implemented in the programming language Genstat.¹³ To express the excess mortality associated with angina we used the population attributable proportion¹⁴—that is, an estimate of the proportion of subjects dying in the population attributable to angina. This is given by:

$$1 - \frac{\text{Prob}\{\text{dying in follow up} \mid \text{angina free}\}}{\text{Prob}\{\text{dying in follow up}\}}.$$

To assess the effect of angina allowing for various confounding effects, together with significance levels, we used a generalised linear modelling approach. Given that P is the probability of surviving the follow up period, we modelled the logistic transformation of P , $\log(P/1-P)$ and also the complementary $\log\{-\log(1-P)\}$, as suggested by Woodbury *et al.*¹⁵ for longitudinal studies. The results were similar for either transformation. The regression coefficient associated with angina, when exponentiated, is termed the odds ratio, and closely approximates the relative risk.¹⁶

Grade 1 angina is defined as pain in the chest that occurs when walking uphill or hurrying which forces the subject to slow down or stop, and which is relieved after 10 minutes' rest. Grade 2 angina is

defined as the pain occurring also when the subject is walking at an even pace on the level. Questions regarding possible infarction—that is, a severe pain across the front of the chest lasting for half an hour or more—were omitted. Since angina is precluded if the chest pain lasts more than 10 minutes, we defined a further classification, consisting of people who get a chest pain provoked by walking at an even pace on the level, which continues for longer than 10 minutes when the subject is resting.

Results

Table 1 shows the prevalence of angina by age group. These figures are somewhat higher than equivalent figures for men,^{3-5 8} but several studies have shown that the prevalence of angina is higher in women than in men.^{6 10 11}

Table 1 Prevalence (%) of angina in women aged 45-74

Age	No angina	Grade 1	Grade 2	Chest pain >10 mins	Total No	No unclassified
45-49	83.7	10.4	3.5	2.4	375	3
50-54	83.8	10.1	4.2	2.0	357	1
55-59	75.3	14.1	8.2	2.4	291	3
60-64	77.3	14.9	6.4	1.4	282	2
65-69	73.9	15.2	8.7	2.2	92	1
70-74	87.1	9.7	3.2	—	31	0
45-74 No	1146	175	79	28	1428	10

Table 2 shows the percentage dead in the follow up period, by age and angina status. The overall mortality for the group with chest pain lasting more than 10 minutes is not very different from that of the "no angina" group, and for all subsequent analyses the two have been pooled. Overall, it appears that mortality is higher for subjects with grade 1 and grade 2 angina but that this excess is mainly confined to women aged 45-54. The high mortality for women over 65 with grade 2 angina is based on six deaths out of nine subjects. A total of 57% of the deaths in the

Table 2 Percentage dead in 12 year follow up: angina group. Figures in parentheses are deaths from coronary heart disease (ICD 410-414, 8th revision)

Age group	No angina	Grade 1	Grade 2	Chest pain >10 mins
45-54	9	20	18	0
55-64	18	22	24	27
65-74	35	24	67	50
45-74	14.5 (3.8)	21.1 (4.0)	26.6 (8.9)	13.8 (0)
No	166 (43)	37 (7)	21 (7)	4 (0)

grade 2 group were due to any heart disease (ICD 393-429) compared with 33% in both the grade 1 and the no angina group. The death rate over time for the angina and no angina groups is plotted in the figure. As would be expected, this shows an increasing hazard for the women with no angina, since they were basically a healthy population to start with. It shows that the angina group have a consistently higher hazard, even 10 years after the survey, although because of the low numbers the hazard plot fluctuates considerably. Table 3 shows the proportion of deaths attributable to angina by age group. It can be seen that over the 12 year follow up angina grades 1 and 2 can be associated with about 15% of deaths in the 45-54 year age group, but that this proportion declines with age. Again the increased rate for angina grade 2 in the 65 and over age group is based on only nine subjects.

Two year death rate by angina grouping.

Smoking is usually a major confounding factor in epidemiological studies but in table 4 we fail to show any relation between smoking and angina. The table shows that the proportion of smokers drops in the older women but there is no consistent relationship with an angina group. Since smoking is an important determinant of subsequent mortality, however, it was retained in the modelling process.

Table 3 Percentage dying attributable to angina*

Age	Angina 1+2	Angina 2 alone
45-54	14.9	2.9
55-64	4.7	2.1
65-74	2.2	7.0

*100 × (1 - prob {dying|angina free}/prob {dying in follow up}).

Table 4 Percentage smokers by angina groups

Age	No angina	Angina group	
		Grade 1	Grade 2
45-54	48	53	50
55-64	31	22	24
65-74	8	6	22

($\chi^2_4 = 4.26$, $p > 0.2$).

Age was originally classified into six groups of five years each and smoking into never smoked, less than four, 4-15, more than 15 cigarettes a day, and ex-smoker. With such a large number of levels of a factor, however, the power to detect interactions is poor, especially since the number of subjects in some of the subgroups is low. To examine the possibility of pooling we performed a multiple logistic regression, with the probability of surviving the follow up as the dependant variable, and with age, smoking, and angina groups as the independent variables. By comparing the coefficients of the regression equation we decided to pool the heavy and medium smoking groups, and also the never smoked and ex-smoker groups. The grade 1 and grade 2 angina groups were not pooled, but the small group with chest pain of more than 10 minutes was combined with the no angina group.

We constructed models based on age, smoking, and angina status to predict the probability of dying or the probability of dying from coronary heart disease in the follow up period. Including smoking in the model did not materially affect the coefficients associated with angina, but reduced the standard errors of the coefficients. We were also able to replace the grouped age factor by the continuous variable age without altering the other coefficients to any degree. The main effects of each factor emerged as significant, at least at the 5% level. For total deaths there was also a significant second order interaction between age and angina. We divided the follow up period into two roughly equal sections. The analysis was conducted, firstly, on subjects who died before 31 December 1972, compared with the survivors, and then on subjects who died between 31 December 1972 and 31 December 1978 compared with those who survived beyond 1978. Table 5 shows the odds ratios, derived from the regression equations. These show that, overall, grade 2 angina carries a slightly higher odds ratio than grade 1, although the difference is not significant. Only the grade 2 angina has an odds ratio significantly different from 1. The pooled odds ratio was 1.52, significantly greater than 1 at the 1% level. Comparing the two follow up periods, we see that the coefficients are similar, implying that the risk does not appear to be changing with time.

Table 5 shows the odds ratio of coronary heart disease for the two grades of angina. The odds ratio for grade 1 angina is close to unity. The risk associated with Grade 2 angina, however, has increased. It would appear that the risk is greater in the early part of the follow up, but the numbers are too small for any real interpretation.

Since the analysis showed a significant age-angina interaction, we analysed the total number of deaths by three 10 year age groups, and the results are displayed in table 6. For grade 1 angina the risk is clearly greatest for the 45-54 age group, with the risk declining with age. The risk to the 65-74 age group is actually less than unity, although the confidence interval includes it. Splitting by age reduces the number in the grade 2 group to such an extent that none of the risk values are significantly greater than 1. Because of the low numbers we have not examined the deaths from coronary heart disease by age group.

Table 5 Risk relative to the angina free group, allowing for age and smoking

		1967-72	1973-78	1967-78
Dependent variable: death in follow up				
Angina grade 1	OR	1.44	1.38	1.39
	95% CI	0.80-2.60	0.87-2.20	0.97-1.98
Angina grade 2	OR	1.67	2.01	1.82
	95% CI	0.77-3.65	1.12-3.61	1.16-2.85
Dependent variable: death from coronary heart disease				
Angina grade 1	OR	0.94	1.16	1.07
	95% CI	0.21-4.17	0.44-3.05	0.47-2.45
Angina grade 2	OR	3.07	2.29	2.35
	95% CI	0.85-11.07	0.76-6.84	1.00-5.53

OR = Odds ratio.

CI = Confidence interval.

Table 6 Risk relative to angina free group

		Age differences		
		Dependent variable: death in follow up 1967-78		
		Age 45-54	55-64	65-74
Angina grade 1	OR	2.39	1.26	0.63
	95% CI	1.35-4.21	0.67-5.55	0.28-1.37
Angina grade 2	OR	2.15	1.40	2.56
	95% CI	0.86-5.37	0.53-3.74	0.87-7.52

Discussion

Rose *et al* have shown that the method of administration of an angina questionnaire can affect the estimates of prevalence.⁴ The prevalence figures agree quite well with those of Tibbling¹⁰ of 13.4% for women aged 55, grades 1+2 in Sweden, and those of

Gutzwiller *et al*⁸ of 11.0% and 4.9% grades 1 and 2 respectively for women aged 50–69 in Switzerland. The Swedish study was conducted by post, whereas the Swiss one was by interviewer in a similar manner to the present study. Male population studies^{4, 5} might lead one to suppose that only our grade 2 angina is the correct definition. Our study also shows that the requirement that the pain should usually go away within 10 minutes is relevant to subsequent mortality. The overall odds ratios of 1.4 and 1.8 for grade 1 and grade 2 respectively compare well with the figure of 1.64 for non-migrant British women given by Feinlieb *et al*.¹¹ The question "Do you get chest pain when walking at an even pace on the level?" would appear to be more specific to heart disease, which was also noted by Zeiner-Henrikson,⁹ for which a higher relative risk is associated. This relative risk would appear to be greatest in the years immediately following the questionnaire. Nevertheless, angina appears to carry a high relative risk of death even six years subsequently.

For women over 45 relative risk is greater in women aged 45–54. The study did not have sufficient numbers of older women to examine whether only grade 2 angina is a serious risk factor in women over 65. The Norwegian study⁹ showed that the risk for grade 2 declined over the age of 65, but that for grade 1 did not. They did, however, report a decline in the risk for the male population.

Thus we have shown that in a Welsh, non-migrant community angina identified by questionnaire is associated with a higher cardiovascular mortality and higher overall mortality, particularly in the 45–54 age group.

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