

Diagnosis of past history of myocardial infarction in epidemiological studies: an alternative based on the Caerphilly and Speedwell surveys

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SUMMARY In epidemiological studies the diagnosis of a past history of myocardial infarction is made from the answer to a single question: "Have you ever had a severe pain across the front of your chest lasting for half an hour or more?" Two additional questions, which form an optional part of the London School of Hygiene and Tropical Medicine chest pain questionnaire, were used in two large community studies, with other information to determine the likely accuracy of the diagnosis ("Did you see a doctor about this pain?" If so, "What did he say it was?") The prevalence of possible myocardial infarction from the use of the single question was significantly higher among men from South Wales than among men from Speedwell, Bristol (10.1% and 6.9% respectively); in contrast, positive responses to the additional questions reduced the prevalence in the two populations to 5.8% and 4.9% respectively. These latter figures are very similar to those of self-reported coronary thrombosis in the two populations. Among subjects with positive responses to the additional questions the prevalence of ECG ischaemia was about 50%; in contrast, the prevalence of ECG ischaemia among those positive *only* to the severe chest pain question was very similar to that among those with no history of chest pain (12%). Preliminary mortality data show a similar classification of level of risk. These findings indicate that the false positive error rate for possible myocardial infarction could be significantly reduced by the use of two additional questions which form an optional part of the London School of Hygiene chest pain questionnaire but are rarely used. However, the present findings relate to populations with uniform levels of adequately accessible medical care; comparisons between populations with different levels of medical care will require cautious interpretation.

Ischaemic heart disease (IHD) has a number of distinct clinical manifestations¹ which include acute myocardial infarction and angina (pectoris) as well as unrecognised or silent myocardial infarction.^{2,3} In epidemiological studies standard questionnaires are used to elicit symptoms suggestive of a past history of myocardial infarction.^{4,5} Two such studies with a common core protocol, each containing samples of over 2000 men, have been carried out recently in South Wales (Caerphilly) and in the West of England (Speedwell, Bristol). Prevalence figures for the presence of symptoms elicited by questionnaire have been reported previously;⁶ 10% of men from Caerphilly and almost 7% of men from Speedwell reported a history of severe chest pain suggestive of a past history of myocardial infarction. In the present

report we examine other evidence for clinical disease—whether a doctor was consulted about the symptoms, and his opinion; correspondence with ECG ischaemia and whether hospital admission occurred—in order to determine whether the epidemiological definition of past history of myocardial infarction can be improved by the use of additional evidence obtained by questionnaire.

Methods

STUDY POPULATIONS AND SURVEY METHODS In Caerphilly, a 100% sample of men was selected from within a defined area: the town of Caerphilly and five outlying villages. The men were chosen by date of birth such that they were aged 45 to 59 years inclusive when seen.

In Speedwell, a 100% sample of men was selected from the age-sex registers of 16 general practitioners

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working from two health centres in east Bristol. The men were chosen so that they were aged between 45 and 59 inclusive on 1 September 1978, immediately before the study started.

In Caerphilly, a total of 2818 men were found to be eligible for inclusion, and in Speedwell the figure was 2550.

At the clinic, in both areas, the London School of Hygiene and Tropical Medicine chest pain questionnaire⁴ was administered to all men, and a 12 lead electrocardiogram was taken. The electrocardiograms were Minnesota coded⁴ by the same two experienced observers for each area. In both areas a series of other questionnaires which included a check list of cardiovascular and related diseases were completed. Survey methods are described in more detail elsewhere.^{6,7}

A past history of possible myocardial infarction is conventionally defined from the chest pain questionnaire as a positive answer to the question, "Have you ever had a severe pain across the front of your chest lasting for half an hour or more?" For those subjects who answer in the affirmative an additional question, "Did you see a doctor about this pain?" is asked, and if a further positive response is given "What did he say it was?". Responses were classified as follows: doctor not visited, not ischaemic, ischaemic, or opinion not given. It is the effect of including these two additional questions into the diagnosis of a past history of possible myocardial infarction that is the major concern of this paper.

Angina is defined from the chest pain questionnaire in the standard manner. It is sub-divided into grade 1 (chest pain only on walking uphill or hurrying) and grade 2 (chest pain on walking at an ordinary pace on the level). In both areas each subject was also asked if he had ever had any of one of a list of disorders; this began with heart attack or coronary thrombosis. Possible replies were "No", "Uncertain" or "Yes".

Two categories of electrocardiographic ischaemia have been defined; probable ischaemia is defined by Minnesota codes 1-1 and 1-2 (major and moderate Q waves); possible ischaemia is defined as 1-3 (minor Q waves), 4-1 to 4-4 (S-T wave changes), 5-1 to 5-3 (T wave inversions), and 7-1 (left bundle branch block). This classification was used by the Whitehall⁵ study. For the majority of analyses probable and possible categories have been combined as any ECG ischaemia.

Results

Of those subjects eligible for inclusion in the survey 2348 (92%) were examined in Speedwell and 2512 (89%) in Caerphilly.

The prevalence of possible myocardial infarction obtained by questionnaire and by other criteria in Caerphilly and Speedwell is shown in table 1.

Table 1 *Number of men with history of possible myocardial infarction by various criteria in Caerphilly* and Speedwell†*

<i>Criterion</i>	<i>Caerphilly (n = 2512)</i>	<i>Speedwell (n = 2348)</i>
Positive response to single severe chest pain question	253 (10.1%)	163 (6.9%)
Positive response to additional severe chest pain questions	145 (5.8%)	116 (4.9%)
Major or moderate Q waves on ECG	98 (3.9%)	88 (3.8%)
Any ECG ischaemia (Whitehall criteria)	353 (14.1%)	345 (14.7%)
Self-reported history of coronary thrombosis	143 (5.7%)	107 (4.6%)

* Mean age of Caerphilly men—52.6 years
 † Mean age of Speedwell men—54.7 years

This shows that the prevalence of possible myocardial infarction obtained by a positive response to a single question is 3.2% higher in Caerphilly than in Speedwell. Use of the additional questions and self-reported history of coronary thrombosis show comparable results and much smaller differences between the two populations, while ECG ischaemia shows a similar prevalence in the two areas. Age-specific prevalence of symptoms and ECG ischaemia have been reported previously.⁶

Of those subjects with severe chest pain a proportion did not visit their doctor; and a further proportion who consulted their doctor were told that their pain was not ischaemic in origin. Table 2 shows these results and that, in both instances, these episodes were reported more commonly in Caerphilly than in Speedwell. In Caerphilly 108 (43%) of the 253 subjects reporting severe chest pain had either not consulted a doctor or had a non-ischaemic diagnosis given; in Speedwell 47 (29%) of 163 subjects reporting severe chest pain came into these categories.

Table 2 *Visit to doctor by men with severe chest pain*

	<i>Caerphilly</i>	<i>Speedwell</i>
Number with severe chest pain	253 (100)	163 (100)
Did not visit doctor	34 (13.4)	14 (8.6)
Visited doctor and he definitely said non-ischaemic	74 (29.2)	33 (20.2)

Percentages in parentheses

Symptoms not resulting in a consultation and those with a non-ischaemic diagnosis have been grouped together as class 1 symptoms of severe chest pain (positive *only* to single question); the remainder, the vast majority of which have been given an ischaemic diagnosis, are combined as class 2 (positive to

additional questions). In a small number of cases the doctor did not pass on his opinion to a subject and these have been included in the class 2 category. Table 3 shows that 145 subjects in Caerphilly (5.8% of all subjects) and 116 subjects in Speedwell (4.9% of total) have been classified as having class 2 symptoms.*

Table 3 *New classification of severe chest pain*

Severe chest pain	Caerphilly	Speedwell
None	2259 (89.9)	2185 (93.1)
Class 1	108 (4.3)	47 (2.0)
Class 2	145 (5.8)	116 (4.9)
Total	2512	2348

Percentages in parentheses

The relationship between each of these classes of symptoms and any ECG ischaemia was then examined. Table 4 shows that the prevalence is very similar in subjects with class 1 symptoms of severe chest pain to that in subjects without symptoms (12–13%). In subjects with class 2 symptoms, however, the prevalence of ECG ischaemia is four times higher, at about 50%.

Table 4 *Severe chest pain and any ECG ischaemia*

Severe chest pain	Caerphilly		Speedwell	
	n	No. (%) with any ECG ischaemia	n	No. (%) with any ECG ischaemia
None	2259	270 (12.0)	2183†	281 (12.9)
Class 1	108	9 (8.3)	47	6 (12.8)
Class 2	145	74 (51.0)	116	58 (50.0)
Total	2512	353 (14.1)	2346†	345 (14.7)

†No ECG for two men

Major or moderate Q waves are taken as being diagnostic of previous myocardial infarction in most studies, and table 5 shows the prevalence of this class of ECG ischaemia (included also in table 4) by each

class of symptom. The prevalence of ECG ischaemia among subjects with class 1 symptoms is perhaps slightly higher than that in subjects without symptoms (2.5%). However, among class 2 subjects the prevalence of major or moderate Q waves, at just over 25%, is ten times higher than that in subjects without symptoms.

Table 5 *Severe chest pain and major or moderate Q waves*

Severe chest pain	Caerphilly		Speedwell	
	n	No. (%) with major or moderate Q waves (1-1 or 1-2)	n	No. (%) with major or moderate Q waves (1-1 or 1-2)
None	2259	55 (2.4)	2183†	55 (2.5)
Class 1	108	3 (2.8)	47	3 (6.4)
Class 2	145	40 (27.6)	116	30 (25.9)
Total	2512	98 (3.9)	2346†	88 (3.8)

†No ECG for two men

Subjects were asked as a routine checklist whether they had ever had a series of illnesses, and the first listed was 'coronary thrombosis' or 'heart attack'. This checklist preceded the chest pain questionnaire and was not amended as a result of the response to the latter. Table 6 shows the prevalence of positive responses to this item of the checklist by the class of symptom for severe chest pain. As may be predicted, only a small percentage of subjects reported a history of coronary thrombosis in the absence of severe chest pain (about 1%). In the case of class 1 symptoms, the prevalence rose to about 4.5% (based on very small numbers). But among those with class 2 symptoms about 74% of subjects reported a positive history of coronary thrombosis.

A proportion of subjects who had experienced severe chest pain might also be expected to have current symptoms of angina as defined by the questionnaire. It may be expected that angina would occur more commonly in severe chest pain classed as ischaemic by doctors rather than in chest pain classed

Table 6 *Severe chest pain and subject's opinion as to his history of coronary thrombosis*

Severe chest pain	Caerphilly			Speedwell		
	n	No. (%) of men with history of coronary thrombosis		n	No. (%) of men with history of coronary thrombosis	
		Uncertain	Yes		Uncertain	Yes
None	2257*	36 (1.6)	31 (1.4)	2184†	17 (0.8)	19 (0.9)
Class 1	108	9 (8.3)	5 (4.6)	47	1 (2.1)	2 (4.3)
Class 2	145	17 (11.7)	107 (73.8)	116	6 (5.2)	86 (74.1)
Total	2510*	62 (2.5)	143 (5.7)	2347†	24 (1.0)	107 (4.6)

Subject's opinion as to his history of coronary thrombosis was unknown for: * 2 men † 1 man

*Includes five subjects with visit to doctor not recorded

Table 7 Severe chest pain and angina

Severe chest pain	Caerphilly		Speedwell	
	n	No. (%) with angina	n	No. (%) with angina
None	2259	134 (5.9)	2184†	130 (6.0)
Class 1	108	13 (12.0)	47	10 (21.3)
Class 2	145	45 (31.0)	116	67 (57.8)
Total	2512	192 (7.6)	2347†	207 (8.8)

† Angina status unknown for one man

as non-*ischaemic*. Table 7 shows that prevalence of angina increases sharply by class of severe chest pain.

In the Caerphilly study subjects were asked if they had ever been admitted to hospital and for the diagnosis of the disorder causing admission. Table 8 shows the prevalence of hospital admission for *ischaemic heart disease* by the class of symptoms of severe chest pain. This shows that almost 56% of subjects reporting class 2 symptoms had been admitted to hospital for IHD in contrast to only 6% of subjects with class 1 symptoms.

Table 8 Severe chest pain and hospitalisation for *ischaemic heart disease*—Caerphilly only

Severe chest pain	Caerphilly	
	n	No. (%) hospitalised for IHD
None	2259	28 (1.2)
Class 1	108	6 (5.6)
Class 2	145	81 (55.9)
Total	2512	115 (4.6)

Preliminary mortality data are now available for these studies. Table 9 shows the mortality from all causes and from IHD (ICD 9th revision, codes

410–414) in men without a history of severe chest pain and in men with class 1 and class 2 symptoms.

Mortality among men with class 2 symptoms is substantially higher than that among men with no symptoms or class 1 symptoms. The majority of men dying from those with class 2 symptoms died of IHD. There are few deaths to date among those with class 1 symptoms but none has been certified as dying of IHD.

Discussion

A previous report from this study⁶ noted that the prevalence figure for a history of severe chest pain was substantially higher in Caerphilly than in Speedwell (see also table 1) and suggested that this might be due to a higher false positive rate in Caerphilly. This is borne out in tables 2, 3, and 7, which show that a smaller percentage of men with severe chest pain did not visit the doctor in Speedwell, a non-*ischaemic* diagnosis was made more commonly in Caerphilly, and angina was more closely associated with severe chest pain in subjects from Speedwell than in subjects from Caerphilly.

The present data suggest that standard questionnaire data may carry a substantial false positive component in eliciting cases of past myocardial infarction. In the conventional diagnosis, the symptoms of severe chest pain are used as a surrogate for possible myocardial infarction. However, 30–40% of subjects with severe chest pain had either not visited a doctor or, having visited, had been given a clearly non-*ischaemic* diagnosis. These subjects, whom we have categorised as having class 1 severe chest pain, were very similar in respect of ECG *ischaemia* to those without symptoms; among those with class 2 symptoms (visited doctor and given *ischaemic* diagnosis) the prevalence of all ECG *ischaemia* was about four times more common

Table 9 Mortality in men with and without history of severe chest pain in Caerphilly* and Speedwell†

Severe chest pain	Caerphilly			Speedwell		
	Total	No. (%) dead		Total	No. (%) dead	
		All causes	IHD (ICD 410–414)		All causes	IHD (ICD 410–414)
None	2259	107 (4.7)	57 (2.5)	2185	83 (3.8)	34 (1.6)
Class 1	108	2 (1.9)	0 (0.0)	47	3 (6.4)	0 (0.0)
Class 2	145	25 (17.2)	22 (15.2)	116	20 (18.1)	17 (14.7)
All men	2512	134 (5.3)	79 (3.1)	2348	106 (4.5)	51 (2.2)

* Mortality to date—mean length of follow-up 5.5 years

† Mortality to first follow-up—mean length of follow-up 3.25 years

(table 4) and for significant Q waves ten times more common (table 5) than among those with no symptoms. Data for the subject's own immediate recollection of whether he had had a heart attack (table 6) and for those classified as having angina by the standard questionnaire (table 7) also suggested that those with class 1 symptoms were more similar to those without symptoms than to those with class 2 symptoms. Preliminary mortality data suggest that class 1 symptoms have no predictive value for future IHD to date (table 9).

These studies were carried out within the United Kingdom, and the populations concerned have similar access to medical care. In different countries, most particularly in the less developed countries, access to medical care, standards of medical practice and diagnostic practices may all be expected to affect the response to the additional questions in the standard chest pain questionnaire. While this may render the use of these questions of uncertain value in comparisons between countries with widely disparate standards of medical care, it may be worth noting that symptoms may be perceived differently in different populations. The present data suggest that men from South Wales may have a different interpretation of severity than is the case for men from Speedwell, and cultural influences on the interpretation of symptoms would also be expected to influence any estimate of the true prevalence of a disease in a population.

In conclusion, standard questionnaire estimates of

possible myocardial infarction (severe chest pain) carry a substantial false positive error rate if ECG ischaemia and medical diagnosis are taken as objective measures. The false positive error rate may be significantly reduced, particularly within countries with uniform standards of medical practice, by two additional questions which are an optional part of the standard London School of Hygiene and Tropical Medicine chest pain questionnaire.

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