Predicting who develops chronic low back pain in primary care: a prospective study

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BMJ 1999;318:1662–7

Abstract

Objectives To quantify the relative contribution of premorbid and episode specific factors in determining the long term persistence of disabling symptoms of low back pain.

Design Prospective cohort study.

Setting Two general practices in the south Manchester area.

Participants 180 patients, who previously participated in a cross sectional population survey, who consulted because of low back pain during the study period. They were followed at 1 week and 3 and 12 months after consultation.

Main outcome measure Persistent disabling low back pain in the 12 months after the consultation.

Results Disabling low back pain persisted in one third of participants after consultation and was more common with increasing age, among those with a history of low back pain, and in women. Persistence of symptoms was associated with "premorbid" factors (high levels of psychological distress (odds ratio 3.3; 95% confidence interval 1.5 to 7.2), poor self rated health (3.6; 1.9 to 6.8), low levels of physical activity (2.8; 1.4 to 5.6), smoking (2.1; 1.0 to 4.3), dissatisfaction with employment (2.4; 1.3 to 4.5)) and factors related to the episode of low back pain (duration of symptoms, pain radiating to the leg (2.6; 1.3 to 5.1), widespread pain (6.4; 2.7 to 15), and restriction in spinal mobility). A multivariate model based on six factors identified groups whose likelihood of persistent symptoms ranged from 6% to 70%.

Conclusions The presence of persistent low back pain is determined not only by clinical factors associated with pain but also by the premorbid state.

Introduction

Each year in the United Kingdom 7% of the adult population present to their general practitioner with low back pain[1] at a cost in excess of £500 million to the NHS.[2] Episodes of acute back pain are perceived to resolve rapidly with only a small proportion of sufferers experiencing persistent or recurrent symptoms leading to disability. Most of the costs linked to the treatment of back pain apply to this small proportion.

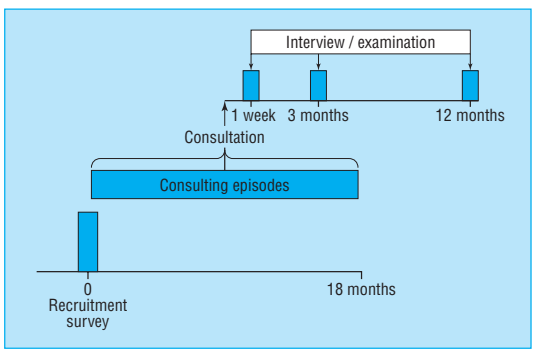
Clearly, it would be advantageous with respect to clinical management to be able to identify at presentation those patients at high risk of persistent disabling symptoms. Prediction of outcome has been examined previously with two main sources of prognostic factors: clinical data directly related to the pain episode and health, lifestyle, and individual factors. In all studies to date, however, health, lifestyle, and individual factors have been recorded after the onset of symptoms and may therefore have been influenced by the pain episode.

We used a prospective design to quantify the contribution, firstly, of health, lifestyle, and individual factors measured before the onset of the episode of low back pain leading to consultation and, secondly, of factors specific to the episode, in predicting the long term persistence of symptoms. We also determined whether subjects at high risk of persistent disabling symptoms can be identified early on the basis of such factors.

Participants and methods

Cohort recruitment

Eligible participants were those registered with two general practices in the south Manchester area who had participated in a previous cross sectional study[3] and had consulted because of low back pain during the subsequent 18 month study period (fig). Ethical approval was obtained from the local health authority. The survey had included information on demographic data, lifestyle factors including levels of physical activity, smoking status, a single question on self rated general health,[4] and the 12 item general health



Summary of design of follow up study of patients with low back pain presenting to primary care

questionnaire[5] to measure participants' levels of "psychological distress" and current (during the past month) and past low back pain. The lower back was defined, on a manikin, as the area bordered above by the 12th rib and below by the gluteal folds.

Current work status was recorded and social class was derived from job title by using the classification method of the Office of Population Censuses and Surveys.[6] Participants were also asked to rate their level of satisfaction either with their current job or their current work status (retired, seeking work, working in the home) with a 5 point scale from "very satisfied" to "severely dissatisfied."

Cohort follow up

During the 18 month study period all consultations for low back pain were identified weekly by using the general practices' computerised records systems. Participants had a home interview and examination carried out by a research nurse. The median time between consultation and the nurse visit was 1 week (interquartile range 1-2 weeks).

The interview after consultation provided information on factors directly related to the episode of low back pain leading to that consultation: duration of current episode, mode of onset (sudden or gradual), radiation of pain to leg (either above or below the knee), and pain elsewhere in the body. The physical examination consisted of five measures of spinal mobility: standing extension, lateral flexion, finger to floor distance, knee extension, and a modified Schober's measurement. Details of the methods used to measure each of these movements have been described previously.[7] Each spinal movement was considered "restricted" at the point that best discriminated between participants consulting because of low back pain and a separate group of people who had never experienced low back pain.[7]

Participants were interviewed again at 3 and 12 months after the initial consultation with the main objective of determining current symptoms (fig).

Outcome

At each of the three interviews participants were asked about the presence of low back pain on that day and asked to mark the severity of any pain on a visual analogue scale from 0 to 10; a score of 0 or 1 was defined as no pain. Disability was measured at each of the three interviews with the Hanover back pain activity schedule.[8] This schedule was developed for use in subjects with back pain and has been found to compare well with other similar instruments. It inquires about the ease of carrying out 12 items of daily activity in the previous 2 weeks, with scores for each item being summed to a percentage value where 100% represents total ability.

The primary outcome considered in this study was "persistent disabling low back pain" defined as the presence of both low back pain and disability (Hanover score $< 75\%$) at each follow up interview (1 week and 3 and 12 months).

Statistical analysis

The analysis examined the relation between persistent disabling low back pain and, firstly, premorbid factors and, secondly, episode specific factors, among those participants who had consulted with an episode of low back pain which started after recruitment to the study. Univariate analysis assessed the individual associations of these putative risk factors and are presented as odds ratios with 95% confidence intervals. When we considered premorbid and episode specific factors together, those variables significantly associated with persistent symptoms were used in a backwards stepwise logistic regression procedure to determine whether a small group of factors could accurately predict those patients who would have persistent disabling symptoms.

A "jack knife" technique was used to test the accuracy of the resulting model. This method involves the removal of data from each participant in turn, and a model is then derived by using the data from the remaining participants. The predicted outcome for the removed participant, on the basis of this model, is then compared with their observed outcome status. This process is repeated for each participant.

All analyses were conducted with the STATA statistical software package.[9]

Table 1 Number (percentage) of patients with disabling low back pain who visited their general practitioner with new episode of pain

Interview	Men	Women	Total
1 week	47 (64)	84 (79)	131 (73)
3 month	28 (38)	59 (56)	87 (48)
12 month	21 (28)	55 (52)	76 (42)
Each time point	18 (24)	43 (41)	61 (34)

Table 2 Association between demographic and premorbid factors and persistent low back pain (univariate analysis)

Characteristic	Persistent low back pain		Odds ratio (95% CI)
	No (n=119)	Yes (n=61)	
Men	56	18	1
Women	63	43	2.12 (1.1 to 4.1)
Age (years)*:			
18-29	16	2	1
30-44	41	16	3.12 (0.6 to 15)
45-59	38	23	4.84 (1.0 to 23)
60-75	24	20	6.67 (1.4 to 33)
General health questionnaire score†:			
12-21	49	10	1
22-48	69	47	3.34 (1.5 to 7.2)
Self rated health†:			
Excellent/good	83	24	1
Fair/poor	36	37	3.55 (1.9 to 6.8)
Physical activity compared with peers†:			
More/same	97	38	1
Less	21	23	2.80 (1.4 to 5.6)
First episode of low back pain†:			
Yes	24	4	1
No	95	57	3.60 (1.2 to 11)
Ever smoked†:			
Never	40	12	1
Ever	79	49	2.07 (1.0 to 4.3)
Alcohol drinker†:			
Weekly	70	23	1
Never/hardly ever	49	38	2.36 (1.3 to 4.4)
Employment status†:			
Working	74	25	1
Not working	45	36	2.37 (1.3 to 4.4)
Satisfied with employment situation†:			
Yes	66	21	1
No	53	40	2.37 (1.3 to 4.5)

*Odds ratios adjusted for sex.
†Odds ratios adjusted for sex and age (four groups).

Results

During the 18 month study period consultations were recorded for 442 of the 4501 participants (9.8%) from the cross sectional study conducted in the study general practices. Interviews 1 week after consultation were completed for 294. We defined a new episode to be where pain that caused the consultation started after the cross sectional survey was carried out, which resulted in the exclusion of 48 participants whose episode of back pain had started before this. Hence 246 subjects were eligible for follow up, of whom 180 provided complete information at 1 week and 3 and 12 months after consultation and are the subjects used in further analyses.

Outcome of low back pain—The percentage of participants who reported disabling low back pain was 73% at 1 week and 48% at 3 months, with only a slight subsequent decrease to 42% at 12 months after consultation. About a third (61; 34%) of participants were classified as having persistent disabling low back pain—that is, low back pain with related disability at each of the three follow up interviews (table 1).

Premorbid factors—Sex and age predicted persistent disabling low back pain: a doubling in odds of a poor outcome was seen for women compared with men (odds ratio 2.1; 95% confidence interval 1.1 to 4.1) and the likelihood of a poor outcome increased with older age. Premorbid factors (that is, measured before the onset of the consulting episode) associated with a poor outcome were high levels of psychological distress, below average self rated health, low levels of physical activity, a history of low back pain, current or previous smoking, a low alcohol intake, not being employed, and dissatisfaction with current employment or work status. Each of the factors was associated with a twofold to fivefold increase in odds of persistent symptoms (table 2).

Table 3 Association between factors specific to episode and persistent low back pain (univariate analysis)

Characteristic	Persistent low back pain		Odds ratio (95% CI)
	No (n=119)	Yes (n=61)	
Duration of pain before current visit (weeks)*:			
0-3	95	40	1
4-12	20	12	1.43 (0.6 to 3.2)
⩾13	4	9	5.34 (1.6 to 18)
Radiating leg pain*:			
No	54	15	1
Yes	65	46	2.55 (1.3 to 5.1)
Widespread pain*:			
No	110	40	1
Yes	9	21	6.42 (2.7 to 15)
Usual duration of low back pain (days)*:			
<7	31	17	1
7-30	34	21	1.01 (0.4 to 2.4)
>30	15	16	1.65 (0.6 to 6.7)
Standing extension*:			
Not restricted	37	9	1
Restricted	71	39	2.26 (0.9 to 5.2)
Finger to floor*:			
Not restricted	67	12	1
Restricted	46	37	4.49 (2.1 to 9.5)
Lateral flexion*:			
Not restricted	82	28	1
Restricted	33	23	2.04 (0.9 to 4.0)
Modified Schober's*:			
Not restricted	95	33	1
Restricted	18	17	2.72 (1.3 to 5.9)
Knee extension*:			
Not restricted	51	16	1
Restricted	36	27	2.39 (1.1 to 5.1)

*Odds ratios adjusted for sex and age (four groups).

Table 4 Predictors of presence of persistent disabling low back pain. Demographic, premorbid, and episode specific factors included in stepwise logistic regression model

Predictive factor	Odds ratio (95% CI)
Men	1
Women	2.26 (1.0 to 5.1)
First episode of low back pain:	
Yes	1
No	2.76 (0.8 to 9.9)
Satisfied with employment situation:	
Yes	1
No	2.62 (1.2 to 5.8)
Radiating leg pain:	
No	1
Yes	1.89 (0.8 to 4.4)
Widespread pain:	
No	1
Yes	3.44 (1.3 to 9.3)
Spinal restrictions:	
None or 1	1
2–5	3.08 (1.3 to 7.3)

Episode specific factors—The strongest episode specific predictor of a poor outcome was the presence of widespread pain (axial skeletal pain in addition to pain above and below the waist and on the right and left side of the body); it was associated with a sixfold increase in odds of a poor outcome (6.4; 2.7 to 15.0). A long duration of symptoms before consultation, the reporting of radiating leg pain, and restriction in spinal movement were also significantly associated with a twofold to fivefold increase in odds of a poor outcome (table 3).

Predicting outcome: multivariate model—All premorbid and episode specific factors that were significantly associated with outcome were candidate variables for a stepwise logistic regression model. The final model consisted of six factors: two premorbid (history of low back pain, dissatisfaction with current employment or work status), three episode specific (widespread pain, radiating leg pain, restriction in two or more spinal movements), and sex (table 4). When we used the jack knife procedure the outcome of 74% of participants was correctly classified with a higher negative predictive value (77%) than positive predictive value (60%). The likelihood of persistent disabling low back pain increased with the number of factors reported: only 6% of the participants who reported fewer than three factors had a poor outcome compared with 70% of participants who reported more than four (table 5).

Non-participants—Among patients who consulted with low back pain and who were eligible to participate in this follow up study, 148 (33%) refused to participate in the initial interview or were not contacted for logistical reasons. Information on premorbid factors found to predict poor outcome is shown for these non-participants compared with participants in table 6. Non-participants were more likely to be women and aged under 45 years but otherwise did not differ. Sixty six participants initially interviewed were subsequently lost to follow up. In table 7 they are compared with those who completed follow up with respect to premorbid and

Table 5 Likelihood of persistent disabling low back pain according to number of risk factors present

No of factors present*	No of subjects†	No with persistent symptoms	Observed percentage with persistent symptoms
Five/six	30	21	70
Four	43	15	35
Three	45	12	27
None/one/two	49	3	6

*Factors predicting persistence: female sex, dissatisfaction with employment situation, history of low back pain, radiating leg pain, widespread pain, two or more restrictions in spinal movement.
†Does not total 180 as subjects with missing data for any of these six risk factors were not included in multivariate model.

Table 6 Differences in premorbid factors between subjects who were and were not interviewed after consultation

	Interviewed after consultation		
Characteristic	Yes (n=294)	No (n=148)	P value*
Men	123	51	0.134
Women	171	97	
Age (years):			
18-29	37	37	0.002
30-44	96	44	
45-59	92	29	
60-75	69	38	
General health questionnaire score:			
12-21	84	40	0.730
22-48	200	103	
Self rated health:			
Excellent/good	166	80	0.769
Fair/poor	127	65	
Physical activity of peers:			
More/same	199	109	0.191
Less	91	37	
Ever smoked:			
Never	81	44	0.631
Ever	213	104	
First episode of low back pain:			
No	60	26	0.538
Yes	230	117	
Alcohol drinker:			
Never/hardly	149	72	0.687
Weekly	145	76	
Satisfied with employment situation:			
Yes	131	55	0.286
No	152	80	

*Groups were compared with χ^2 test.

episode specific factors. Participants lost to follow up were younger but did not differ with respect to any other predictors of outcome.

Discussion

We have previously shown in this population that chronic symptoms are common after consultation for a new episode of low back pain.[10] By using a small group of factors, both premorbid and specific to the episode, we have now shown that it is possible to define groups at high risk of a poor outcome. In comparison with the population reported in our previous paper on outcome,[10] the current study population includes only those who participated in the cross sectional survey, patients consulting with back pain over the subsequent 18 month period (instead of 12 months), and those whose episode of pain started after the population survey.

Comparisons with other studies

Studies examining outcome in a cross sectional fashion at 1 year have found a poor outcome in 30-50% of subjects,[11–14] which is consistent with our finding that 34% of participants have persistent disabling pain. Results from a recent study from the Netherlands found that at 12 months after the initial consultation only 10% still suffered from the same episode of pain which had originally led to consultation and that 75% had reported at least one recurrence in the 12 month period.[15] It is therefore likely that the group in the current study with "persistent" pain are a combination of subjects with continuous pain and those who had one or multiple recurrences during the follow up period.

Although women had a poorer outcome than men, predictors of outcome were similar in both sexes. Previous results from this study have shown that high levels of psychological distress, as measured by the general health questionnaire, and dissatisfaction with employment increase the risk of a future episode of low back pain in patients presenting to primary care among those initially pain free.[16 17] The present study indicates that these factors also influence the persistence of symptoms. Adverse psychological factors have previously been reported to be associated with a poor outcome.[13 14 18–20] In those studies, however, psychological data were collected after the onset of symptoms, making it impossible to determine whether adverse psychological factors predated or were a consequence of pain. By using a prospective design we have uniquely collected psychological information before the onset of pain; and the results suggest that such factors do have an early influence on onset of symptoms and outcome.

In common with other studies of low back pain[13 14] we found that a history of symptoms was highly predictive of persistent symptoms, although, interestingly, the participant's assessment of duration of symptoms in a

Table 7 Differences in premorbid and episode specific factors between subjects who did and did not completed follow up

	Completed 12 month follow up		
Characteristic	Yes (n=180)	No (n=66)	P value*
Men	74	25	0.647
Women	106	41	
Age (years):			
18-29	18	15	0.021
30-44	57	25	
45-59	61	14	
60-75	44	12	
First episode of low back pain:			
Yes	28	12	0.621
No	152	54	
Satisfied with employment situation:			
Yes	87	29	0.607
No	93	36	
Radiating leg pain:			
No	69	29	0.426
Yes	111	37	
Widespread pain:			
No	150	59	0.239
Yes	30	7	
Spinal restrictions:			
⩽1	71	28	0.386
⩾2	96	29	

*Groups were compared with χ^2 test.

previous episode(s) did not predict outcome. This association of outcome with history may indicate that in some people episodes of low back pain after the first become increasingly longer in duration. Alternatively it may simply reflect that people with a previous episode(s) are likely to have future multiple episodes and have been classified with persistent symptoms in this study.

In addition to the premorbid state, several factors specific to the episode were important in predicting outcome. The strongest adverse prognostic factor was when low back pain was part of a more widespread pain syndrome. Chronic widespread pain, the cardinal feature of fibromyalgia, is known to have a poor outcome, particularly when it is associated with high levels of distress.[21] It commonly occurs together with other physical symptoms and may be a manifestation of somatisation. It is therefore not surprising that this subgroup of patients presenting with "low back pain" have a notably poorer outcome. A further "pain distribution" prognostic factor indicative of a poor outcome was the presence of leg pain. This, however, is likely to be mechanical in origin, indicating possible compression of a nerve root or irritation of the spinal canal.[13 14]

In the literature on low back pain much attention has been given to the predictive ability of spinal movements[13 18 22 23]; our study has confirmed that restriction predicts poor outcome. This relation with the persistence of pain could be a direct consequence of spinal restriction—that is, patients with a less mobile spine have more severe symptoms. Alternatively, as suggested in a cross sectional study examining the relation between behavioural and biomechanical factors, restriction may be associated with pain tolerance that is, in turn, subject to psychological influences.[24] A further analysis in the present study, that stratified participants according to high and low levels of psychological distress, showed that restriction in spinal movements predicted poor outcome in both groups, suggesting that the former may be the more likely explanation.

Potential bias

A concern in any follow up study is the possibility of bias occurring due to loss to follow up at various stages. These losses are to some extent inevitable in a study from an urban population. We have investigated the potential for such biases on our results. With the exception of age and sex, participants who were not followed up or who were lost to follow up did not differ from those who were recruited and studied for the entire follow up period in terms of factors that predicted outcome. This increased propensity for loss in the younger participants may be due, in part, to their moving out of the area. These differences would bias our results, however, only if their relation with outcome was different in participants and non-participants. Overall, our data do not suggest any important biases that would prevent our results being extrapolated to all those eligible to be followed up.

Conclusions

In conclusion, we have shown that a substantial proportion of patients who present to primary care with low back pain will have persistent symptoms over the 12 months after consultation. By uniquely collecting data on risk factors before the onset of the pain that resulted in the consultation, we have shown that the presence of persistent low back pain is not only determined by clinical factors associated with pain but also by the premorbid state. On the basis of five variables which are easily collected at the time of consultation and an examination of spinal movement, we were able to define a group who had a high risk of persistent symptoms of low back pain during the follow up year. Furthermore, patients with these adverse prognostic factors are likely to represent those in whom potentially effective interventions would have the greatest impact in terms of morbidity and healthcare costs.

Key messages

- Although many episodes of acute low back pain will resolve rapidly, around 30% result in persistent disabling symptoms
- The presence of persistent low back pain is not only determined by clinical factors at the time of onset but also by the "premorbid" state
- Patients with these adverse prognostic factors represent a group in which effective interventions may result in substantially reduced morbidity and healthcare costs

We thank the partners, staff, and patients of Brooklands and Bowland General Practices, Manchester, for help with conducting the study. Margaret Carrington, Jane Barnett, and Hannah Chambers carried out the study interviews.

Contributors: PRC, AJS, and ACP designed the study protocol, discussed core ideas, coordinated the study, and participated in analysis and interpretation of data and writing the paper. ET and GJM discussed core ideas and participated in data analysis and interpretation and took the lead in the writing of the paper. MIVJ participated in the design and development of the study and the writing of the paper. All the authors are guarantors for the paper.

Funding: Arthritis Research Campaign and the National Back Pain Association.

Competing interests: None declared.

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(Accepted 31 March 1999)

Statistics notes

Variables and parameters

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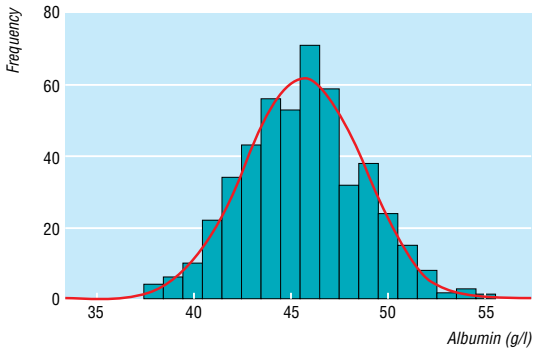
Like all specialist areas, statistics has developed its own language. As we have noted before,[1] much confusion may arise when a word in common use is also given a technical meaning. Statistics abounds in such terms, including normal, random, variance, significant, etc. Two commonly confused terms are variable and parameter; here we explain and contrast them.

Information recorded about a sample of individuals (often patients) comprises measurements such as blood pressure, age, or weight and attributes such as blood group, stage of disease, and diabetes. Values of these will vary among the subjects; in this context blood pressure, weight, blood group and so on are variables. Variables are quantities which vary from individual to individual.

By contrast, parameters do not relate to actual measurements or attributes but to quantities defining a theoretical model. The figure shows the distribution of measurements of serum albumin in 481 white men aged over 20 with mean 46.14 and standard deviation 3.08 g/l. For the empirical data the mean and SD are called sample estimates. They are properties of the collection of individuals. Also shown is the normal[1] distribution which fits the data most closely. It too has mean 46.14 and SD 3.08 g/l. For the theoretical distribution the mean and SD are called parameters. There is not one normal distribution but many, called a family of distributions. Each member of the family is defined by its mean and SD, the parameters[1] which specify the particular theoretical normal distribution with which we are dealing. In this case, they give the best estimate of the population distribution of serum albumin if we can assume that in the population serum albumin has a normal distribution.

Most statistical methods, such as *t* tests, are called parametric because they estimate parameters of some underlying theoretical distribution. Non-parametric methods, such as the Mann-Whitney U test and the log rank test for survival data, do not assume any particular family for the distribution of the data and so do not estimate any parameters for such a distribution.

Another use of the word parameter relates to its original mathematical meaning as the value(s) defining one of a family of curves. If we fit a regression model, such as that describing the relation between lung function and height, the slope and intercept of this line



Measurements of serum albumin in 481 white men aged over 20 (data from Dr W G Miller)

(more generally known as regression coefficients) are the parameters defining the model. They have no meaning for individuals, although they can be used to predict an individual's lung function from their height.

In some contexts parameters are values that can be altered to see what happens to the performance of some system. For example, the performance of a screening programme (such as positive predictive value or cost effectiveness) will depend on aspects such as the sensitivity and specificity of the screening test. If we look to see how the performance would change if, say, sensitivity and specificity were improved, then we are treating these as parameters rather than using the values observed in a real set of data.

Parameter is a technical term which has only recently found its way into general use, unfortunately without keeping its correct meaning. It is common in medical journals to find variables incorrectly called parameters (but not in the *BMJ* we hope[2]). Another common misuse of parameter is as a limit or boundary, as in "within certain parameters." This misuse seems to have arisen from confusion between parameter and perimeter.

Misuse of medical terms is rightly deprecated. Like other language errors it leads to confusion and the loss of valuable distinction. Misuse of non-medical terms should be viewed likewise.

1 Altman DG, Bland JM. The normal distribution. *BMJ* 1995;310:298.
2 Endpiece: What's a parameter? *BMJ* 1998;316:1877.

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BMJ 1999;318:1667