

RISK INDICATORS FOR LOW BACK TROUBLE

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ABSTRACT. A general population of 928 men and women aged 30, 40, 50 and 60 years participated in a health survey with emphasis on low back trouble (LBT). In all 135 variables were analysed to identify possible indicators for first-time experience and recurrence or persistence of LBT during a one-year follow-up. Stepwise logistic regression analyses were carried out to identify the most informative combinations of indicators for prediction of LBT. For men, a high risk for recurrence or persistence of LBT was associated with frequent LBT in the past, worsening of the LBT since its onset, sciatica and living alone. For women corresponding risk indicators were: recency of the last LBT episode, waking up during night because of LBT, aggravation of LBT when standing, rumbling of "the stomach" and smoking. The strongest risk indicators for first-time experience of LBT were epigastric pain, daily smoking and low isometric endurance of the back muscles. In addition, hospitalisations for whatever cause and a long distance from home to work showed predictive power for first-time LBT among gainfully employed participants. The results indicate that persons with either recurring or first-time LBT had more health problems and probably lived under a higher psycho-social pressure than those without LBT in the follow-up year.

Key words: low-back trouble, epidemiology, prospective study, risk indicators, general population, first-time occurrence, recurrence.

Low back pain, or rather low back trouble (LBT) affects 70-80% of all people in the industrialised world at some time during their lives (24, 27). In addition to the subjective discomfort, LBT results in considerable expense, for instance to medical services (30, 41) and in sickness benefits (1, 11, 32).

Despite the appreciable size of this problem, only little is known about risk indicators for LBT, and this emphasises the importance of epidemiological studies, in particular those which employ a longitudinal design. The aim of the present study has thus been through a prospective design to identify risk indicators for recurrence or persistence and for first-time experience of LBT among questionnaire items on medical (including low back), social and occupa-

tional history and among physical measurements relating to the lower back. Multivariate analyses are used to trace the jointly significant indicators among the many individually informative ones.

POPULATION AND METHODS

Of all 30-, 40-, 50-, and 60-year-old inhabitants in the Municipality of Glostrup (a suburb of Copenhagen, Denmark) invited to a free general health survey, 82% (449 men and 479 women) participated (3, 8).

The following information was gained from questionnaires: 51 items concerning LBT (4, 5, 6, 8); 25 variables relating to the history of health, symptoms and diseases, notably cardiovascular, pulmonary, gastrointestinal and urological problems together with general health and contacts with health services; 6 variables on tea, coffee, alcohol and smoking habits; 24 on occupational conditions; and also 13 social and leisure variables (10). One of the authors carried out a physical examination relating to the lower back, comprising anthropometric measurements, flexibility/elasticity measurements of the back and hamstrings, as well as tests for trunk muscle strength and endurance (7).

Twelve months after the examination, 99% of the population examined (442 men and 478 women) completed a follow-up postal questionnaire focussed specifically on LBT in the intervening period (3, 8).

Delimitation of LBT

In all questionnaires, LBT questions were phrased as follows: "Have you ever/within the last 12 months had pain or other trouble with the lower part of your back?" The reproducibility of the history of LBT thus obtained has been found to be satisfactory (9).

Prognostic value

The predictive value for recurrence or persistence (jointly termed recurrence) or first-time experience of LBT in the follow-up year of the above-mentioned parameters was evaluated. This was done by comparing the answers for those with LBT previously and during the follow-up year with those with LBT previously but not during follow-up (Table I). A corresponding set of comparisons was made between those who had their first experience of LBT in the follow-up year with those who had had LBT neither previously nor during the follow-up year (Table I).

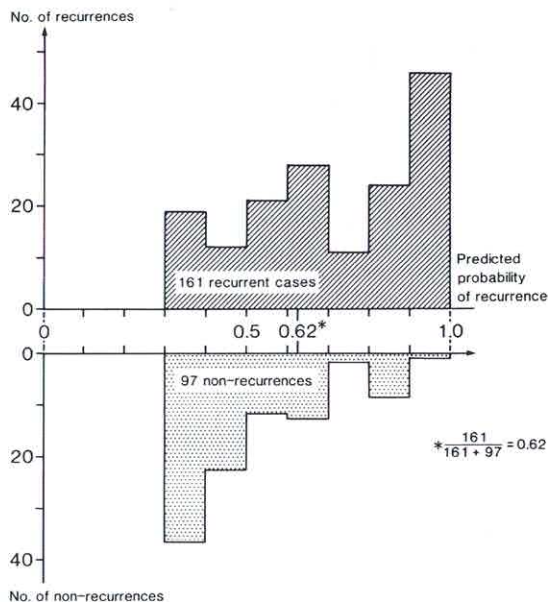


Fig. 1. Predicting LBT recurrence in men. The histograms show the distribution of the estimated risk of recurrence during the follow-up year as predicted by the logistic regression on the basis of the indicators listed in Table II.

The analyses for identifying risk indicators for recurrence were made for men and women separately, whereas the analyses for first-time occurrence were carried out with men and women together because of the small numbers involved.

In previously published papers analyses were carried out to identify which of the above-mentioned parameters taken separately were indicators either for recurrence or for first-time occurrence of LBT. Parameters which were found separately to be indicators have previously been analysed groupwise with multivariate techniques, with the variables grouped into: 1) low back history variables (8), 2) physical measurements variables (7) and 3) other medical, social and occupational history variables (10). In this presentation

Table I. Grouping of the material used in the analyses of variables to evaluate their predictive value for recurrence or persistence and first-time experience of low back trouble (LBT) in a one-year follow-up

	Men	Women	Total
Recurrence or persistence of LBT during follow-up	170	185	355
Previous LBT but not during follow-up	106	108	214
First-time LBT during follow-up	28	30	58
No LBT before or during follow-up	138	155	293

stepwise logistic regression analyses (16) were carried out including those (up to 9) variables which in those latter analyses were found to be significant indicators at a level of $p \leq 0.1$. The output from a logistic regression is a set of factors, known as odds ratios, which are associated with various characteristics that an individual may have. When those factors which apply to a given individual are multiplied together, one obtains the odds of LBT vs. no LBT. The probability that he or she will suffer from LBT during the next 12 months is then found as odds/(1+odds). For instance, odds of 4 to 1 will imply an LBT risk of 0.8. The stepwise procedure identifies the most informative indicant. Next it identifies the most informative pair of indicants by adding another indicant, etc. until none of the remaining indicants add statistically significant information at the five per cent level. Confidence intervals can be calculated for the factors, odds and risks, but we shall not go into any detail.

RESULTS

The life-time prevalences for the 30-, 40-, 50-, and 60-year-old for LBT were 54%, 61%, 64%, and 70% for both genders together, and the one-year prevalence for LBT in the follow-up year was 45% in average for all age groups and both genders. Recurrence or persistence of LBT in the follow-up year was reported by 62% of those with a history of LBT. New cases were reported by 17% of those who had no such history. Cf. Table I.

Table II describes the indicators which proved significant predictors of recurrent LBT. The resulting prediction rules are given in Table III (males) and Table IV (females). While the estimated recurrence risk are given explicitly for males, a corresponding tabulation for females would be unwieldy, requiring 144 entries, so only the necessary factors are given together with an instruction for the risk calculation.

The degree of separation achieved in males is illustrated in Fig. 1. It is modest, although the indicators do make it possible to identify some men with almost certain recurrence. It is noteworthy that even the lowest-risk category has a recurrence risk of 31% (upper left-hand entry in Table III). The overall frequency of recurrence, equal to the average predicted risk, is 0.62 (marked). For females the analogous graph would look similar except that there are a few women at very low risk. They are those who have had no LBT for several years, or had LBT relieved by standing. Note that the subject's age per se did not come out statistically significant.

The indicators for first-time experience of LBT are described in Table V, whilst the resulting prediction rules are given in Tables VI-VII. When the analysis was restricted to those employed, age was also a sig-

Table II. The variables which in the stepwise logistic regression analyses showed to be the strongest indicators ($p \leq 0.05$) for recurrence or persistence of low back trouble (LBT) in the follow-up year

Total numbers used in the frequency-calculations are given in brackets

	Recurrence or persistence of LBT during follow-up	Previous LBT but not during follow-up
<i>Men</i>		
Course of LBT since onset	(166)	(101)
Less pronounced	34%	56%
Unchanged	49%	43%
Worse	17%	1%
How often LBT	(168)	(102)
In all a couple of times	15%	33%
A couple of times yearly	30%	50%
A couple of times monthly	21%	12%
A couple of times weekly	11%	3%
Daily-constant	22%	2%
Ever sciatica	43% (168)	24% (106)
Living alone	14% (169)	4% (105)
<i>Women</i>		
Last time LBT in relation to the day of examination	(184)	(106)
On the examination day	35%	8%
≤ 1 week	21%	12%
> 1 week, ≤ 4 weeks	20%	21%
> 4 weeks, ≤ 1 year	16%	29%
> 1 year, ≤ 5 years	6%	14%
> 5 years	2%	16%
Woke up at night because of LBT	35% (185)	23% (102)
Standing	(169)	(82)
Aggravated LBT	37%	21%
Had no influence	59%	70%
Relieved LBT	4%	10%
Rumbling of "the stomach"	39% (180)	20% (103)
Daily smoking	53% (185)	38% (108)

Table III. Predicting the recurrence of low back trouble (LBT) in men using the indicators shown in Table II (upper part): estimated risk based on the logistic regression model

Answer combinations which occurred 6 times or more in the analysis of 258 subjects are shown in bold-face print; those which did not occur are parenthesized. The overall performance of this prediction chart can be gleaned from Fig. 1. The standard error of the risk estimate is always less than 0.08 for the frequent combinations

		Living alone?					
		No			Yes		
		Course since onset?					
		Less	Unchanged	Worse	Less	Unchanged	Worse
Ever sciatica?							
No							
	How often LBT?						
	a	.31	.39	(.83)	.62	.70	(.95)
	b	.34	.42	.85	.65	.73	(.95)
	c	.60	.68	.94	.85	.89	.98
	d	.75	.81	.97	(.92)	.94	(.99)
	e	.82	.87	.98	.95	.96	.99
Yes							
	How often LBT?						
	a	.52	.60	(.92)	.80	(.85)	(.98)
	b	.55	.63	.93	.82	(.86)	.98
	c	.78	.83	.97	.93	.95	(.99)
	d	.88	.91	.99	(.96)	(.97)	(1.0)
	e	.92	.94	.99	.98	.98	1.00

a: in all a couple of times; b: a couple of times yearly; c: a couple of times monthly; d: a couple of times weekly; e: daily or constantly.

Table IV. Predicting low back trouble (LBT) recurrence in women using the indicators shown in Table II (lower part)

The logistic regression odds are calculated by multiplying the factors which apply to a given individual. The risk of recurrence is then found as odds/(1 + odds). The analysis included 240 subjects

Predictor	Factor
Last LBT episode	
Today	4.41
≤1 week ago	1.29
1-4 weeks ago	0.68
4-52 weeks ago	0.31
1-5 years ago	0.26
More than 5 years ago	0.10
Woke up at night because of LBT	3.77 (otherwise, 1.0)
Effect of standing on LBT	
Aggravates	1.97
None	1
Relieves	0.077
Rumbling of the "stomach"	3.48 (otherwise, 1.0)
Daily smoking	2.03 (otherwise, 1.0)

nificant predictor, but the age pattern did not make biological sense, so we chose to disregard this, presumably fortuitous, finding. Note that gender was not a significant predictor.

No significant interactions were recognised between the predictors identified in these analyses.

Table V. The variables which in the stepwise logistic regression analyses showed to be the strongest indicators ($p \leq 0.05$) for first-time experience of low back trouble (LBT) in the follow-up year

Men and women together. Total numbers used in the frequency calculations are given in brackets

	First-time LBT during follow-up	No LBT before or during follow-up
Pain in the top of the stomach (epigastric pain)	21% (58)	7% (292)
Hospitalised at least once ^a	62% (58)	45% (291)
Number of hospitalisations ^b		
Mean	1.7	1.1
Median	0.9	0.4
Daily smoking	72% (58)	52% (293)
Distance in kilometers from home to work ^a		
Mean	12.1	7.6
Median	9.7	5.4
Isometric endurance of the back muscles (sec) ^c		
Median	205	223
240 sec (maximum) reached	43%	48%

^a Variable which only showed significant predictive power in the analyses restricted to participants gainfully employed at the time of the examination.

^b Additional information which was not made available to the stepwise logistic regression program.

^c This variable did not show significant prediction in the analyses restricted to participants gainfully employed at the time of the examination. Those subjects who could not complete the test without pain have been excluded in those calculations where a test result is needed. The test was discontinued by the examiner after 240 sec.

DISCUSSION

Methodological remarks

Considering the total number of variables included in the study, i.e. 135 in all, and 50 less in the analyses of first-time experience of LBT, only few came through the various levels statistical analyses and proved to be significant indicators in the final analyses. This demonstrates how important it is to carry out multivariate analyses in epidemiologic studies like the present one when evaluating the predictive power of multiple variables, because of the often very strong correlation between them. However, from a cluster of inter-correlated variables typically only one will be picked out by the regression procedure. Within such a cluster of variables there may be several with about the same predictive power and the particular selection is a matter of randomness in the data.

Returning to Tables III and IV, it should be understood that either format is suitable for presentation of logistic prediction rules for clinical use. Many published applications have only given the results in the form produced by computer packages, i.e. in terms of Napierian logarithms. These are indispensable in the statistical analysis but ought, in our opinion, to be converted to the format of Table IV or, if convenient, that of Table III.

Table VI. Predicting first-time low back trouble (LBT) during 12 months of follow-up using the indicators described in Table V

The risks are based on a logistic regression analysis of 294 men and women. A more refined prediction rule applicable to individuals gainfully employed is given in Table VII. The standard error of the risk estimate is always below 0.11

	Daily smoking?			
	No		Yes	
	Rare	Frequent	Rare	Frequent
Isometric endurance of the back muscles				
≥240 sec	.07	.16	.16	.32
125-239 sec	.05	.12	.13	.26
<125 sec	.16	.32	.32	.54

Discussion of risk indicators

Considering the risk indicators for recurrence it is apparent that the previous low back history has the greatest importance, i.e. frequent, recent and increasing symptoms. The high significance of previous low back symptoms as a predictor of future symptoms has previously been demonstrated in longitudinal studies in various selected groups (13, 15, 19, 29, 32, 35, 40).

Radiating pain to the leg has also in other studies showed to be a risk indicator for LBT (29, 35), and Magora & Taustein (26) showed that persons who had experienced sciatica had sick leave more often and of longer duration than those without sciatica. The previously found correlation between pain or discomfort in the lower limbs including intermittent claudication and LBT (10, 18, 19, 33) can most probably be explained by a strong correlation with sciatic pain (10).

Like sciatica, waking up during the night because of LBT and aggravation of the LBT by standing probably indicate more severe pain and thus a condition which is more likely to recur.

Among the 25 medical history variables only rumbling of "the stomach" in women came through in the multivariate analyses as indicators for recurrence of LBT. In addition epigastric pain proved to be an indicator for first-time experience of LBT. These symptoms, which might be considered psychosomatic, have also in other studies shown a correlation with LBT (2, 36, 37).

Apart from the mentioned gastrointestinal

parameters previous hospitalisations were found to be an indicator for first-time occurrence of LBT. This has never been observed before although Nagi et al. (28) found a more frequent use of hospital facilities among LBT-complainers.

Daily smoking showed to be a significant indicator both for recurrence of LBT among women and for first-time experience of LBT. Several studies have found smoking and/or coughing to be risk factors for LBT (17, 18, 19, 21, 25, 33, 36). Various possible mechanisms have been postulated, e.g. smoking produces chronic cough, which in turn gives rise to increased mechanical stress including higher pressure on the discs. The reason might also be that smoking causes a reduction in vertebral-body blood flow, which might adversely affect discal metabolism, making the disc more vulnerable to mechanical deformation (18). The possible correlation between smoking and vertebral osteoporosis has also been discussed (33). Microfractures thus produced in the trabeculae of the vertebral bodies might be responsible for some LBT. On the other hand, Hansson et al. (20) found a positive correlation for men between the mineral content of the third lumbar vertebra and smoking. One might also review available epidemiological data and postulate that there could be a correlation, not ruled out in the present multivariate analyses, to the effect that people with more health problems and social problems in general smoke more frequently and vice versa.

The finding of an association between recurrent LBT and being a man living alone coincides with previous experience (19, 28, 36, 38). Reisbord & Greenland (31) found similarly high prevalence of back

Table VII. Predicting first-time low back trouble (LBT) in men and women gainfully employed, using the indicators described in Table V

The logistic odds are calculated by multiplication of the relevant factors. The risk is then found as odds/(1 + odds). The analysis included 281 subjects

Predictor	Factor
Baseline (obligatory factor)	0.019
Frequent epigastric pain	2.23 (otherwise, 1.0)
One or more hospital admissions	3.43 (otherwise, 1.0)
Daily smoking	2.55 (otherwise, 1.0)
Distance to work	
zero	1
10 km	1.61
25 km	3.29
x km	1.61 ^{x/10}

pain among no-longer-married women. This emphasizes that the LBT sufferers may belong to a group exposed to a higher social and psychological pressure than the average population.

Although several occupational-history variables were included in the study, only one manifested itself as an independent indicator, i.e. distance to work for those experiencing LBT for the first time. The major ground for not detecting occupational factors as risk indicators for LBT in the present study might have to be found in the population studied. Previous studies identifying occupational risk factors have primarily been carried out in selected high-risk populations, while the present study population was a general urban population and the work histories were inherently inhomogeneous in ways which are not captured by our questionnaires. In addition the choice of occupation might have been influenced by previous health problems including LBT.

The possible correlation between motor vehicle transportation and LBT as here indicated has been pointed out in several other studies (12, 14, 18, 22, 23, 25). Primarily, vibration seems to be a significant factor in increasing LBT risk (23, 34, 39).

Among the physical measurements none came significant through in the multivariate analyses for recurrent LBT, which has been shown in previous analyses of the material (7). For first-time experience of LBT only the isometric endurance of the back muscles was found to be a significant indicator, although the previous analyses (7) showed this only to be true for men. That a high isometric endurance of the back muscles should protect to some extent against LBT would seem to be explained by the fact that the back muscles maintain the erect posture of the spine throughout the day. Such endurance is probably also essential in many manual handling procedures, including lifting and load carrying.

Regarding recurring LBT it was found that whatever relation might exist between the physical measurements and recurrence, it was represented by the association to the other presented variables, not least the recency and severeness of previous LBT. Thus for recurrence of LBT, the physical measurements do not seem to be of very high value as indicators if a history already obtained has revealed recent or severe LBT episodes.

Our results indicate that persons with either recurring or first-time LBT had had more health problems and probably a higher psycho-social pressure than those without LBT in the follow-up year. In this con-

nection it is important that none of the variables analysed showed trends in the opposite direction (10).

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