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Back pain, back abnormalities, and competing medical, psychological, and social factors as predictors of sick leave, early retirement, unemployment, labour turnover and mortality: a 22 year follow up of male employees in a Swedish pulp and paper company

N-E ÅSTRAND, S-O ISACSSON

From the Department of Community Health Sciences, Lund University, Malmö, Sweden

ABSTRACT A total of 391 male employees in a Swedish pulp and paper company were followed up for 22 years. As a part of a health examination in 1961 back pain reported by the subjects and abnormalities of the back as judged by the physicians were investigated with respect to predictive power regarding sick leave, early retirement, unemployment, labour turnover, and mortality during the follow up period. Univariate analysis showed that abnormalities of the back were better than back pain for predicting early retirement. Neither back pain nor back abnormalities had any predictive power with respect to long term sick leave, labour turnover, or mortality. Multivariate analyses of 26 variables were performed. Both self assessment of general health and back abnormalities were predictive for early retirement with a diagnosis of back disorder on the retirement certificate but self assessed health was a stronger predictor. Age, smoking, and neuroticism were predictors regarding early retirement for all diagnoses. Education had a negative association; neuroticism did not predict early retirement with a diagnosis of back disorder.

The cumulative incidence of low back pain during a lifetime is reported to be 51–80% among men and women in different occupations and of different ages.[1 2] The prevalence of back pain measured as yes-answers to a question regarding frequently perceived back pain was reported to be 22% among 35–64 year olds of both sexes in a community population in Ohio, USA,[3] and 25% in the present group of 391 men aged 35–65.[4]

Svensson defined the prevalence of low back pain as continuous or regularly recurring low back trouble with a frequency of at least once a month and reported a figure as high as 31% among 940 men, aged 40–47, in Gothenburg.[5] Thus back pain is a common complaint. Statistics from the National Swedish Social Insurance Board show that in 1976 13% of early retirements in Sweden were caused by back complaints.[6]

The long term natural history of back pain has not been investigated. Prospective studies usually cover a period of not more than a year,[7–9] although Rowe has reported a follow up of considerably longer duration.[10 11] He followed up 500 male patients from Kodak Park Works of Eastman Kodak Company in the United States referred for an orthopaedic opinion during a 10 year period. An outstanding feature in about 85% of the patients was the episodic nature of the disorder. Rowe found no objective signs to preselect those not progressing to further low back disability.

An understanding of the long term effects of back disorders, as shown by perceived pain or medical examination, is a prerequisite for an assessment of the need for preventive measures and their likely effect. Interest in this area of preventive medicine is not confined to occupational health departments.

The present study is based on a 22 year follow up of 391 male employees in a Swedish pulp and paper company. The aim was to examine the predictive power of back pain and the findings of a medical examination of the back in respect to future disability reflected in sick leave, early retirement, unemployment, labour turnover, and mortality, and in the

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case of positive findings to analyse the predictive power of possibly competing social psychological and medical factors.

Material and methods

Material and methods have been described in an earlier cross sectional study.[4] Briefly, the subjects comprised 391 male employees in Svenska Cellulosaaktiebolaget (SCA), a Swedish pulp and paper company. All men who were, at the time of the examination in 1961, aged 35, 45, 55, or 65 (or as close to the respective ages as possible to get age groups of about 100) were invited to take part. The difference between stipulated and actual age was smaller than two years for 92% of subjects.

Manual workers, foremen, clerks, engineers, and managers, were invited and the participation rate was 83%. Subsequently all employees except manual workers will be referred to as clerks.

Modernisation of the production units, carried out in gradual stages during the follow up period until 1983, had resulted in more supervisory duties and less continuous physical strain as well as a reduced exposure to heat, moisture, cold, draught, and noise.

The individual examination performed in 1961 covered one day. Ten subjects a day went through medical, sociological, and psychological examination. The medical examination began with a questionnaire, a Swedish modification of the Cornell Medical Index.[12-14] Thirty two questions under the psychiatric part of the questionnaire constituted a scale of neuroticism, the Marke-Nyman scale of neuroticism.[15]

A physical examination of the thoracic and lumbar regions of the back was performed, including inspection, palpation, bending forwards and sidewards, straight leg raising test, dorsal flexion of the foot and big toe, and Achilles tendon reflexes.

Sick leave for 1962–70 was recorded in 1972 and for 1972–83 in 1984 from the public social insurance offices. Sick leave in 1971 was, for administrative reasons, recorded from the employer's registers and not used in the present study.

Early retirement before 65 with a disability pension is subsequently referred to as early retirement and covers cases with temporary or permanent, partial, or complete disability pensions.

Information as regards early retirements during 1961–83 including all diagnoses obtained from the medical certificates for early retirement were recorded from the public social insurance offices in 1984.

Cases with a diagnosis indicating some disorder in the thoracic or lumbar areas of the back are subsequently referred to as early retirement with a diagnosis of back disorder. This diagnosis is not necessarily the main diagnosis.

The main diagnoses at early retirement were recorded from the National Insurance Board in 1986. The register regarding main diagnoses starts with the year 1971. We could record the main diagnoses in the period July 1961–December 1970 only when the certificate contained one diagnosis. Therefore the main diagnosis register is not complete and it is used in this study only for the secondary analysis commented on in the discussion.

Unemployment data were obtained from the public employment offices.

Labour turnover was defined as subjects leaving the company for reasons other than death, old-age pension, or early retirement. Information as regards the month and year when leaving the company was obtained from the local staff offices.

Deaths were reported by the public social insurance offices. Diagnoses of death were obtained from the National Central Bureau of Statistics. All individuals except for three emigrants had their vital status reliably assessed for 31 December 1983.

The central variables for this study are:

(1) Yes- or no-answers to the question: "Do you often have lumbago or pain in your back"? in this report called back pain.

(2) The summing up of the symptoms and signs elicited during the examination of the back, resulting in the classification of the back as normal or abnormal.

The competing variables used in the covariate analyses were chosen according to the model of Palmore *et al*[16] comprising demographic, socioeconomic and health factors, job characteristics, and attitudes to retirement. The latter factor is omitted in the present data material. Variables known to be associated with back pain and back abnormalities were included.

Special attention is devoted to neuroticism which was found to be strongly associated with back pain and back abnormalities in a cross sectional study of the present subjects.[4]

Different reference groups have been used in this study and definitions will be found below when the results are presented.

The predictive power of back pain and back abnormalities as reflected in early retirement, labour turnover, and mortality was investigated for the whole period. Sick leave and unemployment was only partially investigated because of lack of unambiguous long term effects and late and few cases respectively in preliminary analyses.

STATISTICAL METHODS

Sick leave was analysed by linear regression. Early retirement, labour turnover, and mortality were analysed by use of life table analysis. Early retirements

without diagnoses of back disorder and subjects over 65 or dead were censored in the analysis of early retirement with a diagnosis of back disorder. Subjects over 65 or dead were censored in the analysis of all early retirements. The corresponding censoring in analysis of labour turnover were performed for complete early retirement, age over 65, and death.

The regression analysis of Cox was used for the multivariate analyses concerning early retirement. p Values $<0{\cdot}05$ were considered significant and the Cox regression was performed in a stepwise manner with the variables back pain and back abnormalities included if $p < 0{\cdot}1$.

Univariate analyses showed significant predictive power of back pain and back abnormalities only as regards early retirement and accordingly the mutlivariate analyses were confined to this end point.

Results

SICK LEAVE

The sick leave in this sample was low; fewer than half the subjects had any sick leave in each year. Four groups were defined for the analysis of their relation to sick leave:

(A) Subjects with neither back abnormalities nor reported back pain in 1961.
(B) Subjects with back abnormalities in 1961.
(C) Subjects with reported back pain in 1961.
(D) Subjects with both back pain and back abnormalities in 1961.

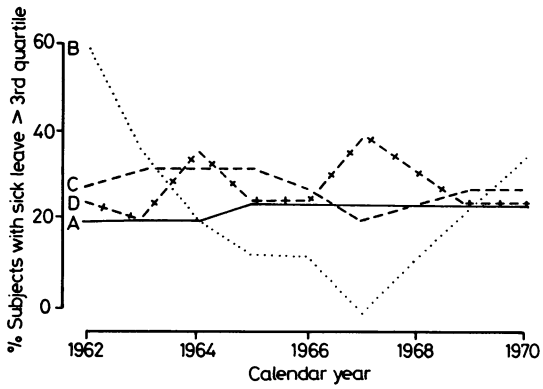

Fig 1 *Sick leave during the period 1962–70. Percentage of subjects in each group with number of sick leave days over 3rd quartile of distribution of sick leave days for all subjects. (A) Neither back abnormalities nor reported back pain in 1961———; (B) back abnormalities at examination in 1961.....; (C) reported back pain at examination in 1961 – – – –; (D) both back pain and back abnormalities in 1961 –+–+–+–+.*

The proportion of subjects per group with a number of sick leave days greater than the third quartile of the total distribution of sick leave days was studied for the four groups during the period 1962–70 (fig 1).

Only group B exhibits systematic temporal changes but these are U shaped and show no linear trend. Therefore, the mean yearly sick leave days, corrected

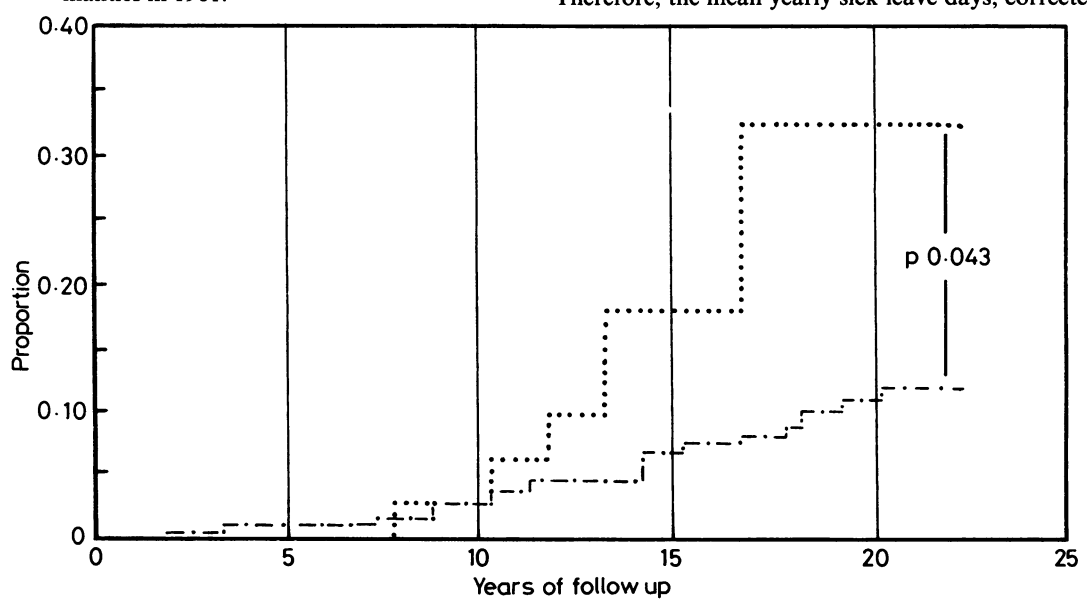

Fig 2 *Cumulative proportion of early retirement with a diagnosis of back disorder 1961–83. Life table analysis. No back abnormalities at examination in 1961 .–.–.–.–. Number of subjects at start = 314. Back abnormalities at examination in 1961..... (n = 59).*

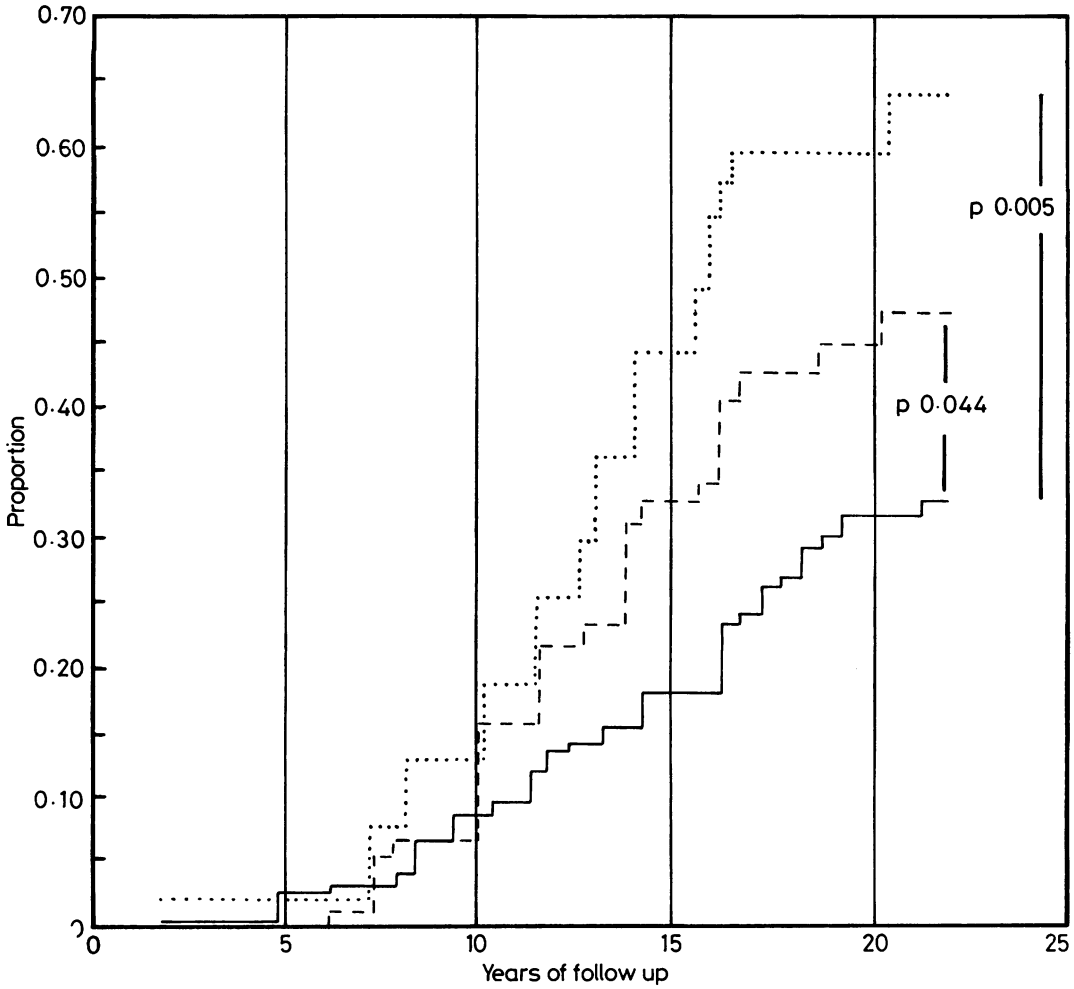

Fig 3 *Cumulative proportion of all early retirements 1961–83. Life table analysis. Neither back abnormalities nor reported back pain at examination in 1961* ————. *Number of subjects at start = 259. Reported back pain at examination in 1961 (n = 93)* – – – –. *Back abnormalities at examination in 1961 (n = 59)* .....

for person-years of observation, was used to study the relation to the groups in a linear regression model, with adjustment for age, during the period 1962–70. Only minor and insignificant differences were found.

The sick leave for 1972–83 was preliminarily investigated and did not show any differences between the groups.

Sick leave for 1971 was, for administrative reasons, recorded from the employer's registers and not from the public social insurance offices. This record did not cover subjects who had turned to other employers and therefore was not analysed in this study.

EARLY RETIREMENT WITH A DIAGNOSIS OF BACK DISORDER

There were 30 cases of early retirement with a diagnosis of back disorder on the retirement certificate during the 22 year observation period. During the follow up those with back pain showed no significant difference in the rate of early retirement with a diagnosis of a back disorder compared with a reference group consitituted of all subjects without back pain.

Figure 2 shows the proportion of early retirement with a diagnosis of back disorder among subjects

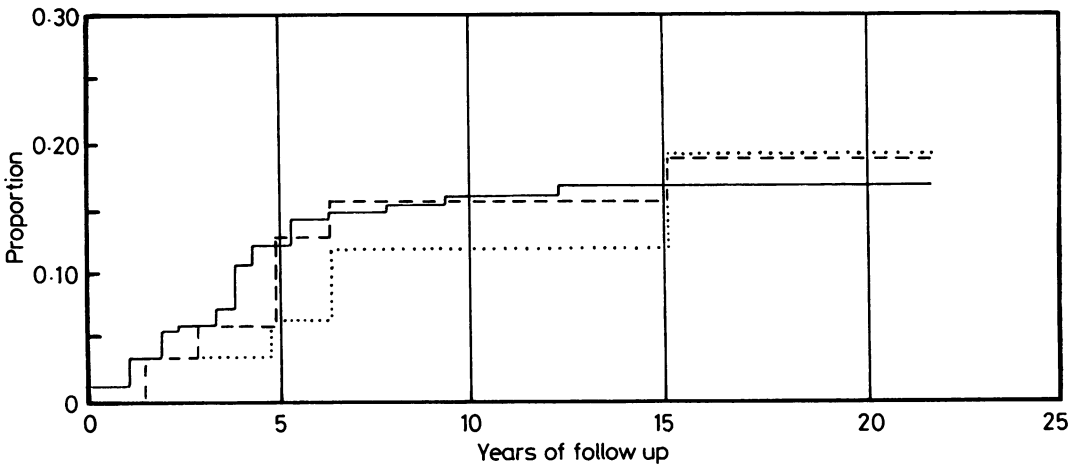

Fig 4 *Cumulative proportion of labour turnover among manual workers 1961–83. Life table analysis. Neither back abnormalities nor reported back pain at examination in 1961* ————. *Number of subjects at start = 260. Reported back pain at examination in 1961 (n = 94)* – – – – –. *Back abnormalities at examination in 1961 (n = 59)* .....

evaluated as having back abnormalities at the examination in 1961 compared with the reference group without back abnormalities. The former had a higher proportion of early retirement with a diagnosis of back disorder than the reference group. The difference was significant (p = 0·043).

The probability of an early retirement with a diagnosis of back disorder was estimated to be 33% for the group with back abnormalities and 12% for those without.

EARLY RETIREMENT: ALL DIAGNOSES

A total of 87 cases of early retirement appeared during the follow up period.

Figure 3 shows the proportion of early retirement among subjects who reported back pain in 1961, subjects with back abnormality, and a reference group comprising all subjects who had neither back pain nor back abnormalities at the examination in 1961.

Subjects with back abnormalities in 1961 had the highest total early retirement. Comparison with the reference group showed a statistically significant difference (p = 0·005).

Subjects with reported back pain in 1961 also had a significantly higher total proportion of early retirement than the reference group (p = 0·044).

The probability of an early retirement (any diagnosis) was estimated to be 66% for the back abnormalities group, 48% for the back pain group, and 33% for the reference group.

UNEMPLOYMENT

A total of 43 cases of unemployment was reported to the public employment offices during the follow up period. The normal retirement age for manual workers was 67 in the first 15 years of the follow up and 65 for the next 17 years. The retirement age for clerks was 65 throughout the period. In the interests of comparison unemployment after the age of 65 was not considered.

Only 18 cases of unemployment were noted below the age of 65 the majority of which occurred one month to two years before age 65. Therefore no further analysis was performed.

LABOUR TURNOVER

It was previously established that managers and engineers in this company move to other employers partly to advance their career and it was supposed that the reasons for turnover were not the same among manual workers. Accordingly, labour turnover was investigated among manual workers. A total of 50 workers left the company for reasons other than retirement or death. Since unemployment was shown to be short and uncommon in this industry this means that most of these 50 workers found other employment or started their own businesses.

Figure 4 shows the turnover for the groups with reported back pain and with back abnormalities compared with subjects with neither. There was no statistical difference with respect to turnover in the group with back pain compared with the reference group (p = 0·786) or the group with back abnormalities and the control group (p = 0·562).

The figure shows that in this company there was practically no turnover among manual workers except in the early years of employment.

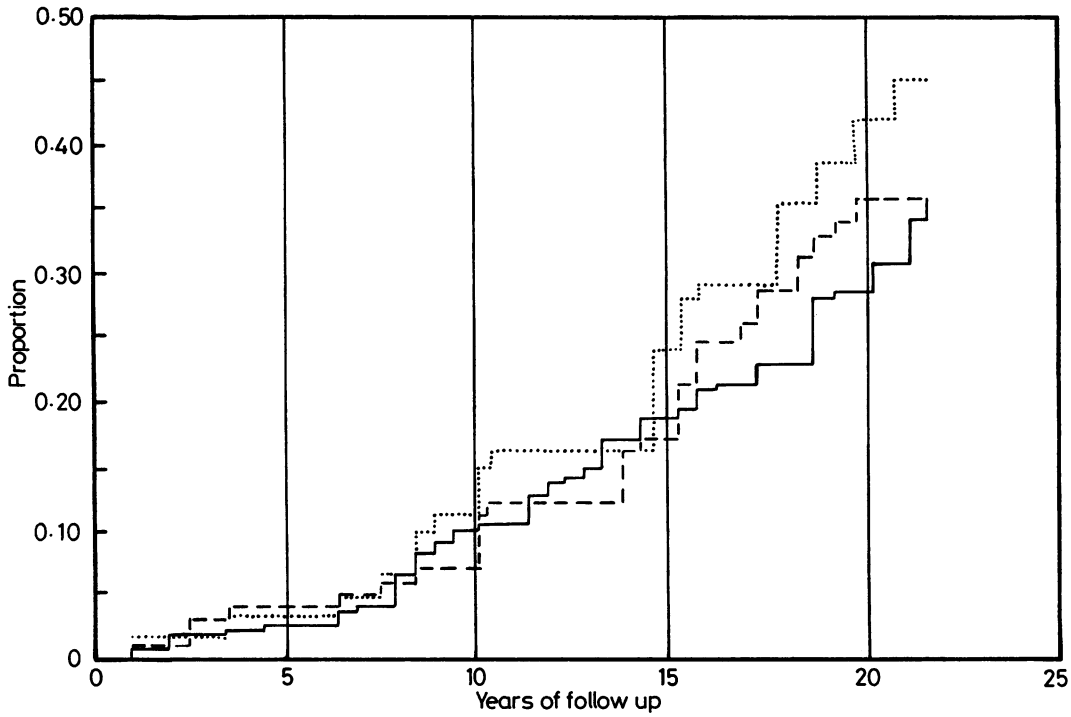

Fig 5 *Cumulative mortality 1961–83. Life table analysis. Neither back abnormalities nor reported back pain at examination in 1961* ————. *Number of subjects at start = 265. Reported back pain at examination in 1961 (n = 96)* – – – –. *Back abnormalities at the examination in 1961 (n = 61)* .....

MORTALITY

A total of 151 subjects died during the observation period. Figure 5 shows the mortality for subjects with back pain, subjects with back abnormalities, and subjects with neither. There were no significant differences in mortality between the groups (p = 0·78 and 0·13 respectively).

MULTIVARIATE ANALYSES

Back pain and back abnormalities were analysed with respect to predictive power regarding early retirement with a diagnosis of back disorder together with neuroticism and 23 variables chosen according to the model of Palmore *et al*[16] (tables 1 and 2). Back pain did not show any direct prediction and back abnormalities showed a relative risk of 2·4 (p = 0·053), see table 3.

Other variables were better predictors of early retirement with a diagnosis of back disorder. Self assessed health perceived as worse than very good according to a dichotomised five grade scale was the best predictor, showing a relative risk of 3·4 (p = 0·011) and systolic blood pressure was second with a risk of 1·4 per 10 mm Hg increase (p = 0·004). Neuroticism did not enter the equation (p > 0·2). The same 26 factors were tested for predictive power with respect to early retirement, all diagnoses (table 4).

Back pain or back abnormalities did not show any significant prediction at multivariate analysis with respect to early retirement, all diagnoses. Age as expected showed a direct association. The relative risk per additional ten years was 4·4 (p < 0·001). Education showed a protective effect manifested as a relative risk of 0·8 for a difference of one year's education (p = 0·004). Smoking showed a relative risk of 1·8 (p = 0·020). Neuroticism dichotomised at the upper decile of yes-answers showed a relative risk of 1·9 (p = 0·039).

Discussion

Sick leave in this study was low but, as with other endpoints in this study, it may be at least partly due to a healthy worker effect.[17 18] The personnel administration has reported a high quality of recruited personnel, made possible by the local labour market situation

Table 1 *Description of variables used in multivariate analysis*

	Variable	*Yes*	*%*	*No*	*%*	*Min*	*Max*	*Median*
Variables of central interest for the present study	Back pain	98	25	289	75			
	Back abnormality	61	16	326	84			
	Neuroticism (a total sum of 6 or more yes-answers to 32 questions)	45	12	345	88			
Demographic	Age					31	68*	48
Socioeconomic variables	Period of lack of food at adolescence	61	16	322	84			
	No of persons per room in parents' home during adolescence					0	16	4
	Education (years at school)					3	17	6
	Occupational status (manual worker = yes)	297	76	94	24			
	Duration of employment (years)					0	60	13
Tests regarding mental ability	Test "synonyms" (number of correct answers)					0	30	19
	Instruction test (number of correct answers)					1	22	14
	Test "arithmetics" (number of correct answers)					1	36	28
Health risk indicators	Use of alcohol	309	79	81	21			
	Smoking	253	65	135	35			
	Systolic blood pressure					105	230	140
	Diastolic blood pressure					65	115	85
	Serum cholesterol > 300 mg/100 ml	70	18	320	82			
	Chest pain	57	15	328	85			

*Age 65 and over censored.

during all periods of major recruitments.

The present production units were run mainly on continuous shift and low sick leave among shift workers compared with day workers was reported by Taylor.[19]

Several publications report that back disorder is accompanied by increased sick leave[5 20 21] and that this persists prospectively for one or two years.[7 21]

The present study does not contradict the presence of an initial high amount of sick leave among subjects with back abnormalities or reported back pain but indicates no long term rise in sick leave. This could be due to the following possible course of events.

(1) Subjects with back disorder are eliminated by retirement to a larger extent than subjects without.

(2) Transfers of subjects with back disorder were common in this population.[4] This diminishes the work load and equalises the levels of sick leave.

(3) New cases of back disorder appear with time in the reference group.[11]

It must be pointed out in this connection that it is shown in an earlier study of the same subjects that both the group with back pain and the group with back abnormalities showed significantly more days taken as sick leave than reference groups in 1960—that is, the year before the investigation.[4]

Back pain did not show any significant prediction of early retirement with a diagnosis of back disorder by lifetable analysis but back abnormality did. Comparable results cannot be found in publications regarding back disorders since no investigation using back pain and back abnormality as competing predictive factors seems to have been performed.

In multivariate analysis regarding early retirement with a diagnosis of back disorder back abnormalities were shown to be the third predictive factor, situated on the borderline of statistical significance whereas self assessed health was shown to be the most significant.

Table 2 *Description of variables used in multivariate analysis*

	Variable	*Yes*	*%*	*No*	*%*
Evaluation of general health	Self assessment of general health (best alternative = very good = yes, any of four other alternatives = no)	122	32	263	68
	Doctor's evaluation of general health and working capacity (good = yes; any of three other alternatives indicating reductions = no)	301	77	89	23
Self assessed work environment factors	Work in a cold environment	92	27	250	73
	Physically heavy workload	58	16	314	84
	Frequent lifting at work	82	22	289	78
	High degree of responsibility at work	356	92	29	8
	Work characterised as routine work	192	50	191	50
	Work characterised as self dependent	345	90	40	10

Table 3 *Predictors of early retirement with a certified diagnosis of back disorder, analysis with covariates–Cox models*

Variable	*Coefficient*	*Standard error*	*p*	*Relative risk*
Self assessment of health as worse than very good	1·222	0·544	0·011	3·4 (1·1–10·1)
Systolic blood pressure	0·034	0·011	0·004	1·4* (1·1– 1·8)
Back abnormality	0·878	0·424	0·053	2·4 (1·0– 5·6)

*Relative risk represents the effect of a 10 mm Hg increase in systolic blood pressure.

Self assessed health is a potent predictor of early retirement[16] and mortality.[22]

Olin reported an association of self assessed bad health with nervous symptoms, but whether nervous symptoms lead to an assessment of health as bad or if perceived bad health leads to nervous symptoms is not known.[23]

The multivariate analysis did not show neuroticism as a predictor of early retirement with a diagnosis of back disorder. This was contradictory to the finding in a cross sectional study carried out on the present population, showing neuroticism as strongly associated with both back pain and back abnormalities.[4]

The association of back pain with neuroticism is well established in publications about back disorders as shown in studies of hospital patients[24–26] and in a community population.[3]

The present result suggests that the well known association of neuroticism with back disorders could be an expression of a neurotic development secondary to perceived back disease.

Systolic blood pressure showed the second strongest association with early retirement with a diagnosis of back disorder. The relation of low back pain to cardiovascular risk factors was investigated earlier by Svensson in a cross sectional study but no direct associations were shown except for smoking.[5] A cross sectional study of back pain performed on the present subjects gave no evidence for any association of back pain or back abnormalities with smoking or other cardiovascular risk factors.[4]

In fact, diagnoses of cardiovascular disease made up a large proportion of the diagnoses listed on the certificates for early retirement with a diagnosis of back disorder.

Since both back disorders and cardiovascular diseases are common diagnoses on early retirement certificates their twin appearance is probably fortuitous. An analysis restricted to cases in which a diagnosis of back disorder constituted the main cause of the early retirement was performed. In this analysis systolic blood pressure had no predictive power.

Table 4 *Predictors of early retirement, all diagnoses. Analysis with covariates — Cox models*

Variable	*Coefficient*	*Standard error*	*p*	*Relative risk*
Age	0·150	0·020	0·000	4·5 (3·0–6·7)*
Education	−0·171	0·071	0·004	0·8 (0·7–1·0)†
Smoking	0·567	0·254	0·020	1·8 (1·1–2·9)
Neuroticism	0·655	0·294	0·039	1·9 (1·1–3·5)

*Relative risk represents the effect of a difference of 10 years in age.
†Relative risk represents the effect of a difference of one year in education.

If back pain or back abnormalities were associated with cardiovascular risk factors back pain or back abnormalites should reasonable have shown a predictive power with respect to mortality in the lifetable analysis. This was not so.

Smoking did not show any predictive power regarding early retirement with a diagnosis of back disorder. Thus this study gives no support for the suspicion that smoking could be an aetiological factor for back disorders.[5 27]

Life table analysis showed both back pain and back abnormalities as significant predictors of early retirement, all diagnoses, but none was a significant predictor in the multivariate analysis.

Age, as expected, was the strongest predictor, followed by education, smoking, and neuroticism. Education showed a negative association. Education is an indicator of socioeconomic status and low education as predictor of early retirement fits well with a report by Palmore *et al.*[16]

Smoking is a well known predictor of chronic bronchitis, bronchial cancer, and cardiovascular disease, and Lannerstad reported an association of smoking with the disability pension rate by univariate analysis in a five year follow up.[28]

Back pain or back abnormalities showed no predictive power with respect to labour turnover. The investigation of professional drivers by Backman and Järvinen reported physical heavy work and health factors as common reasons for labour turnover, especially in those over 45, whereas dissatisfaction with wages was the most common reason for labour turnover in younger drivers.[29] The lack of predictive power of back pain and back abnormalities with respect to labour turnover in this study has to be seen against the local background. The company has a solid reputation for personnel care including occupational health facilities and the possibility of transfers.

Neither back pain nor back abnormalities showed any predictive power regarding mortality, which is in accordance with expectations since back disorder is not reported to be a cause of death.

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References

1 Hult L. Cervical, dorsal and lumbar spinal syndromes. A field investigation of a non-selected material of 1200 workers in different occupations with special reference to disc degeneration and so-called muscular rheumatism. *Acta Orthop Scand* 1954;suppl XVII.

2 Hult L. The Munkfors investigation. *Acta Orthop Scand* 1954;suppl XVI.

3 Nagi SZ, Riley LE, Newby LG. A social epidemiology of back pain in a general population. *J Chronic Dis* 1973;**26**:769–79.

4 Åstrand NE. Medical, psychological and social factors associated with back abnormalities and self reported back pain. *Br J Ind Med* 1987;**44**:327–36.

5 Svensson HO. *Low back pain in 40 to 47 year old men: a retrospective cross-sectional study*. Gothenburg: University of Gothenburg, 1981. (Thesis.)

6 National Swedish Social Insurance Board. *Early retirement pensions granted in 1976*. Stockholm: National Swedish Insurance Board, 1978.

7 Troup JDG, Martin JW, Lloyd DCEF. Back pain in industry. A prospective survey. *Spine* 1981;**6**:61–9.

8 Lloyd ECEF, Troup JDG. Recurrent back pain and its prediction. *J Soc Occup Med* 1983;**33**:66–74.

9 Biering-Sörensen F. A one-year prospective study of low back trouble in a general population. *Dan Med Bull* 1984;**31**:362–75.

10 Rowe ML. Low back pain in industry. *J Occup Med* 1969;**11**:161–9.

11 Rowe ML. Low back disability in industry: updated position. *J Occup Med* 1971;**13**:476–8.

12 Abrahamson JH, Terespolsky L, Brook JG, Kark SL. Cornell medical index as a health measure in epidemiological studies. A test of the validity of a health questionnaire. *Br J Prev Soc Med* 1965;**19**:103–10.

13 Brodman K, Erdmann AJ, Wolff HG. *Cornell medical index—health questionnaire (manual)*. New York: Cornell University Medical College, 1965.

14 Nyman GE, Marke S. *Medical questionnaire*. Lund: Lund University, 1958. (In Swedish.)

15 Marke S, Nyman GE. Somatic and mental complaints in a young population. *Socialmed Tidskr* 1961;**38**:315–23. (In Swedish.)

16 Palmore EB, George LK, Fillenbaum GG. Predictors of retirement. *J Gerontol* 1982;**37**:733–42.

17 Koskela RS. Occupational mortality and morbidity in relation to selective turnover. *Scand J Work Environ Health* 1982;**8** suppl 1:34–9.

18 Sterling TD, Weinkam JJ. The "healthy worker effect" on morbidity rates. *J Occup Med* 1985;**27**:477–82.

19 Taylor PJ. Shift and day work. A comparison of sickness absence, lateness, and other absence behaviour at an oil refinery from 1962 to 1965. *Br J Ind Med* 1967;**24**:93–102.

20 Faxén N. Morbidity statistics on material from a public health insurance office. *Nord Med* 1959;**23**:638–41. (In Swedish.)

21 Westrin CG. Low back sick-listing. *Scand J Soc Med* 1973;suppl 7.

22 Palmore EB. Predictors of the longevity difference: a 25-year follow up. *Gerontologist* 1982;**22**:513–8.

23 Olin RO. *Health status of elderly residents in Stockholm*. Stockholm: Karolinska Institutet, 1971. (Thesis in Swedish.)

24 Hanvik LJ. MMPI-profiles in patients with low-back pain. *Journal of Consulting Psychology* 1951;**15**:350–3.

25 Leavitt SS, Johnston TL, Beyer RO. The process of recovery. Part 3. Mapping the health care process. *Industrial Medicine and Surgery* 1972;**41**:7–11.

26 Donovan W, Dwyer AP, White BWS, Batalin NJ, Skerritt PW, Bedbrock GM. A multidisciplinary approach to chronic low-back pain in Western Australia. *Spine* 1981;**6**:591–7.

27 Frymoyer JW, Pope MH, Constanza MC, Rosen JC, Goggin JE, Wilder DG. Epidemiologic studies of low-back pain. *Spine* 1980;**5**:419–23.

28 Lannerstad O. Morbidity related to smoking and other risk factors. *Scand J Soc Med* 1980;**8**:25–31.

29 Backman AL, Järvinen E. Turnover of professional drivers. *Scand J Work Environ Health* 1983;**9**:36–41.