

Low-back pain in commercial travelers

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PIETRI F, LECLERC A, BOITEL L, CHASTANG J-F, MORCET J-F, BLONDET M. Low-back pain in commercial travelers. *Scand J Work Environ Health* 1992;18:52-8. The role of occupational environment in the occurrence of low-back pain was analyzed for 1719 commercial travelers (1376 men and 343 women). At the beginning of the study (T₀) the group was interviewed to determine current lifestyle and occupational factors associated with low-back pain during the previous 12 months. Twelve months later (at T₁), a subsample of 1118 persons (893 men, 225 women) was reinterviewed to study the association between the incidence of low-back pain during the year of follow-up and the risk factors at T₀. At T₀ low-back pain was significantly related with time spent driving a car at work, comfort of the car seat, carrying loads during work, standing for long periods at work, smoking, and psychosomatic factors. At T₁ driving 10 h/week or more, seat comfort, and psychosomatic factors were associated with first occurrence of low-back pain.

Key Terms: carrying loads, driving, incidence, occupational environment, prevalence, psychosomatic factors.

Low-back pain is considered an important public health problem because of its high frequency and its heavy socioeconomic burden (1-3). According to various studies, 60 to 80% of the general population has or has ever had low-back pain (4-8), and back problems are responsible for between 9 and 19.5% of all sick leave days (9). Several studies have been carried out in the general population and in the work environment in order to determine the role of various individual, social, and occupational factors in the occurrence of this disorder. In the literature, the most consistent result is a nonlinear increase in prevalence with age (5, 10-12). Although some authors found a higher prevalence among women (5, 10, 13), one study showed that men had a higher prevalence of the lumbar disc syndrome (12), and others did not find any relationship with the gender of the individual (8, 14). With regard to marital status, the prevalence of low-back pain seems to be higher for people living alone (10, 11, 13, 14). However people who have never been married were found to be at the lowest risk in three of the studies (10, 11, 13) and at the highest risk in one (14). Other factors such as educational level or tobacco consumption have been studied and will be discussed later. Most of the etiologic factors have been studied in the work environment, and the most consistent results are related to the lifting of heavy loads (7, 8, 15-19), and the driving of motor vehicles (8, 19-21). Other factors, such as sedentary work or con-

siderable physical effort at work, have also been studied, but the results are less consistent (11, 13, 14).

A national survey of a group of 1719 commercial travelers and 861 sedentary workers was carried out in France between 1 October 1985 and 30 September 1986 in order to compare the occupational risk factors and morbidity of commercial travelers with those of a reference group of white-collar workers. The results of this study have been reported elsewhere (22). The homogeneity of the group of commercial travelers with regard to the kind of work constraints they experienced led us to carry out a complementary study limited to this occupational group. This study focused on low-back pain in relation to lifestyle and the work environment. In this article we report the prevalence and incidence of low-back pain and their association with other factors for the group of commercial travelers.

Subjects and methods

Study design

This national survey was conducted in 11 medium-size towns in France by a group of 74 physicians in cooperation with research workers. The physicians worked with the same organization [Centre d'Information des Services Médicaux d'Entreprises et Interentreprises (Information Center for Medical Services in Small or Medium Size Firms)] and were in charge of the medical surveillance of employees who worked in a wide range of occupations. In France, most employees undergo a compulsory medical examination each year.

Each person in the survey was interviewed during the annual medical examination. The interview, lasting 10-20 min, was performed by the physician. It included questions about life-style, work conditions, and

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a list of health problems. For nonmedical variables, the physician asked questions exactly as they were in the questionnaire, and the measures of exposure were based on self-declarations of the subjects. For the health variables, possible sources of bias due to physicians were discussed with them before the survey and at the beginning of the data collection, in order to standardize their approach.

The sampling procedure was as follows: each physician participating in the survey had a quota of sedentary workers and commercial travelers to interview in each quarter of the year. The first person to meet the inclusion criteria in each half-day of routine examination was included until the quota for the quarter was reached. This sampling procedure was simple and avoided recruitment bias because the arrival order of employees relies on an administrative procedure and is not under the control of the physicians.

The inclusion criteria for the commercial travelers were: (i) employed in a job involving soliciting orders and selling goods, products, and services to retailers, industrial consumers, institutional and professional establishments, or private persons; (ii) employed in a job involving visiting clients for more than half of the time.

The International Standard Classification of Occupations (23) would classify persons in this group in categories 4.32 (commercial travelers and manufacturers' agents), 4.31 (technical salesmen and service advisors), and 4.41 (insurance, real estate and securities salesmen).

All of the individuals in this group had similar work conditions. They were responsible for an allotted geographic area, which involved many driving hours and working far from home, sometimes for more than a day. They had to eat at restaurants alone or with clients. Some of them had heavy samples of goods to carry, although the physical constraints were not as severe as for many groups of blue-collar workers.

We intended to recruit physicians for the survey in every large and medium-size town in France, but it was not possible in Paris and Marseille. As a consequence, the sample is representative of commercial travelers in medium-size towns. Another limitation is that employees in the largest firms (which have their own medical services), and self-employed workers (who do not have annual medical visits as a benefit) were excluded.

This was a cross-sectional and longitudinal study based on two interviews conducted as has already been described. The first one was carried out at the beginning of the survey (T_0) and concerned health problems during the past 12 months and risk factors at T_0 (cross-sectional study). The second one was conducted among the same workers 12 months later (T_1) and mainly concerned health problems during the year of follow-up (longitudinal study). Most of the risk factors were not recorded at T_1 .

In all, 1719 commercial travelers (1376 men and 343 women) were interviewed in the cross-sectional phase (T_0). Some of the physicians did not volunteer for the

longitudinal phase of the study (T_1), which reduced the sample to 1381 subjects, who had the same characteristics as the group as a whole. Of these, only 1118 persons (893 men and 225 women) could be interviewed. The other 263 subjects could not be traced by the physicians, mainly because they were no longer employed in the same firm or they had moved. The workers lost to follow-up were younger and slightly healthier than the rest of the sample.

Ten subjects were excluded from the analysis because their age was unknown. The numbers of subjects were thus reduced to 1709 at T_0 and 1115 at T_1 .

Analysis

The effects of various factors, such as sociodemographic characteristics, life-style [especially tobacco and alcohol consumption, sports], work environment (eg, hours spent driving, lifting and standing), and psychosomatic factors] were studied.

The following two measures of low-back pain were used in the study: (i) one-year prevalence of low-back pain in the cross-sectional study, defined as the proportion of persons who had had low-back pain during the 12 months prior to the interview at T_0 , irrespective of whether the symptoms were new, and (ii) one-year cumulative incidence of low-back pain, which was determined from a question of whether the persons had had new symptoms of low-back pain during the year of follow-up. The annual incidence was calculated for the subjects who had never had low-back pain until T_0 . Among them, incident cases were defined as persons having had low-back pain for the first time in their life between T_0 and T_1 .

All types of low-back pain were recorded, irrespective of whether the symptoms were severe or not.

In the analyses, risk factors were determined at T_0 only. The following two analyses were performed: (i) prevalence of low-back pain in relation to risk factors at T_0 and (ii) incidence of low-back pain in relation to risk factors at T_0 .

The study on prevalence was cross-sectional and performed on the sample as a whole. The study on incidence was a cohort study with a prospective follow-up period of one year, restricted to the subsample of people interviewed in the longitudinal study (T_1) who had never had low-back pain before T_0 .

For the study on incidence, it was decided to limit the list of risk factors to those recorded at T_0 in order to be sure that the risk factor was present before the onset of the disease and therefore avoid record bias.

The variables used in the analysis are described in tables 1—3. They concern sociodemographic data (age, marital status, number of children, educational level), life-style (playing a sport, consumption of coffee, tobacco and alcohol), weight, height, body mass index, general work conditions (duration of employment as commercial traveler, time per week spent at work and driving, number of kilometers per year), physical con-

Table 1. Sociodemographic characteristics of the men and women separately at the time of the cross-sectional phase of the study (T_0).

Gender	Age (years)		Living alone (%)	Number of children (%)				Years of educational level (%)		
	Mean	SD		0	1	2	≥ 3	<12	12	>12
Men (N = 1368)	38.7	9.5	8.8	32.2	25.7	30.4	11.8	44.1	27.3	28.6
Women (N = 341)	37.6	9.4	23.6	47.3	25.0	21.1	6.5	40.4	25.8	33.8

Table 2. Life-style and physical characteristics of the men and women separately at the time of the cross-sectional phase of the study (T_0).

Gender	Alcohol consumption (glasses/d)		Coffee consumption (cups/d)		Tobacco consumption (%)			Regular sport (%)	Weight (kg)		Height (cm)		Body mass index (weight/height ²)	
	Mean	SD	Mean	SD	Current smokers (≥ 1 cigarettes/d)	Ex-smokers	Non-smokers		Mean	SD	Mean	SD	Mean	SD
Men (N = 1368)	2.6	2.6	2.8	2.3	52.9	10.6	36.5	42.5	75.8	10.9	174.7	6.2	24.8	3.4
Women (N = 341)	0.8	1.5	2.9	2.2	40.4	3.3	56.3	37.6	57.9	9.1	162.5	5.9	21.9	3.2

Table 3. Work characteristics of the men and women separately at the time of the cross-sectional phase of the study (T_0).

Gender	Time employed as a commercial traveler (years)		Time worked/week (h)		Distance driving/year (km)		Time driving/week (h)		Frequent load carrying (%)	Frequent prolonged standing (%)	Frequent stair climbing (%)
	Mean	SD	Mean	SD	Mean	SD	Mean	SD			
Men (N = 1368)	11.9	8.5	50.6	9.9	44 322	17 110	16.7	6.8	31.3	45.5	30.5
Women (N = 341)	7.1	6.1	45.0	14.2	31 509	18 101	15.0	7.7	67.0	52.7	54.5

straints at work (carrying loads, standing, climbing stairs). Information about the vehicle used at work and a list of 10 questions about psychological problems, especially symptoms of depression and psychosomatic problems, was also included. These characteristics are described in the following list: (i) *type and comfort of the vehicle*: commercial car/company car/personal car, four-door saloon/hatch/station wagon/other, comfortable seat (yes/no), seat modified by the driver (yes/no), effective headrest (yes/no), pedals in satisfactory position (yes/no), easy access to trunk (yes/no), automatic gear shift (yes/no), tinted windshield and windows (yes/no), satisfactory sound proofing (yes/no), power steering (yes/no), deflectors (yes/no), satisfactory ventilation system (yes/no), driving with open windows (yes/no), automatic windows (yes/no), driving with safety belt (yes/no), number of kilometers at change of car, general satisfaction with the vehicle (very satisfied/satisfied/moderately satisfied/not satisfied); (ii) *psychosomatic factors*: (a) have you recently suffered from migraine or headache (yes/no), trouble in getting to sleep or staying asleep (yes/no), tetany or spasmophilia (yes/no), (b) are you usually in very good spirits or good spirits versus low spirits or very low spirits, (c) are you ever bothered

by nervousness (irritable, fidgety, tense) (often versus sometimes or never), (d) have you ever been bothered by your heart beating hard (often versus sometimes or never), (e) have you worries which make you physically ill (yes/no), (f) do you feel that nothing ever turns out for you the way you want it to (yes/no), (g) do you sometimes feel that you can't help wondering if anything is worthwhile anymore (yes/no), (h) does your job make problems in your marital or family life (yes/no). The questions about psychological problems were derived from Langner's screening questionnaire (24). The number of answers expressing psychosomatic symptoms, from 0 to 10, was used in the analysis to evaluate the magnitude of psychosomatic problems as a whole.

The logistic model was used for the two analyses utilizing BMDP (biomedical data package) computer software (25). Odds ratios were calculated in both analyses, and relative risks were calculated in the incidence analysis.

First, all of the variables were entered, one by one, with age in a model. Only those significantly correlated with low-back pain were entered together in the multivariate logistic regression presented in this report.

Since the multivariate analysis by gender showed the same trends in risks and were consistent with the overall analysis, and since the number of women was small, especially in the longitudinal study, both genders were grouped in the analysis. Possible interactions between gender and other risk factors were not studied since gender was not significantly associated with low-back pain in the multivariate analysis.

Description of the sample

A description of the sample, by gender at T_0 , is presented in tables 1–3. Some differences were observed between the men and women. The men had worked as commercial travelers longer than the women, but they did not differ in age. Most of the men did not live alone. Alcohol consumption was higher among the men, and there were more smokers and ex-smokers among the men than among the women. Coffee consumption and regular participation in a sport did not differ between the men and women. The men spent more time at work, especially driving, but the women complained more often about the physical constraints of their job.

Results

The prevalence and incidence of low-back pain are shown for the sample in table 4. At T_0 and T_1 , the women had a higher prevalence of low-back pain than the men. The incidence was also higher for the women than the men.

Prevalence of low-back pain in relation to other factors at T_0

Using a multivariate logistic regression model, we compared the subjects with low-back pain in the 12 months preceding T_0 with those without low-back pain during this period (table 5). The strongest relationships with low-back pain were observed for driving (only the risks associated with driving more than 20 h/week being significant), comfort of the seat, and psychosomatic factors, the odds ratio increasing with the number of symptoms. The odds ratio was also significantly different from unity for the smokers. Standing

and carrying loads was found to be associated with low-back pain with an odds ratio close to unity. Age and gender were not significantly associated with low-back pain when the other risk factors were taken into account.

Incidence of low-back pain in relation to other factors at T_0

The incidence of low-back pain in relation to risk factors at T_0 is shown in table 6. Because the analysis was restricted to people never having experienced low-back pain before T_0 , only 627 subjects were included.

An association was found between the comfort of the car seat and the occurrence of low-back pain as a new disorder during the year of follow-up. For time spent driving there was an association, but it was significant only for driving between 10 and 20 h/week. A significant excess risk also remained for subjects having a sum of three or four psychosomatic symptoms. Carrying loads, standing, and smoking did not prove to be predictive factors of low-back pain.

Discussion

In our study, the one-year prevalence of low-back pain varied from 25.1 to 28.2% for the men and from 34.9 to 37.5% for the women. In the literature, the one-year prevalence varied between 14 and 45% for the general population (5, 13, 26) and between 20 and 62% for workers (7, 11, 14). However, it is difficult to compare these results since the definition of the cases varied considerably according to the author.

The one-year incidence was estimated as 13% in our study. Only a few other studies have estimated the incidence of low-back pain. The incidence has been shown to range between 6% for the general population (5) and 11.7% for company employees (11).

With regard to the sociodemographic factors associated with low-back pain in the cross-sectional study, we found a borderline significant increase in the one-year prevalence with age (table 5). However, this association was observed for the men only (results not presented here), and it slightly differs from results of other authors (6, 11).

Table 4. Prevalence and cumulative incidence of low-back pain among the men and women separately.

Gender	Cross-sectional study (T_0)				Longitudinal study	
	Whole group		Subgroup ^a		Persons in group (N)	Cumulative incidence of low-back pain ^c (%)
	Persons in group (N)	Prevalence of low-back pain ^b (%)	Persons in group (N)	Prevalence of low-back pain ^b (%)		
Men	1368	25.1	891	28.2	514	12.6
Women	341	34.9	224	37.5	113	16.8

^a Subgroup = persons interviewed for the longitudinal study.

^b Prevalence during the 12 months preceding the beginning of the study.

^c Incidence from the beginning of the study (T_0) to the end of the follow-up (T_1).

Table 5. Unconditional odds ratios (OR) for the one-year prevalence of low-back pain during the 12-month period preceding the cross-sectional phase of the study (T_0) and the sociodemographic data, life-style, work environment, and psychosomatic factors at that time.

	Subjects ^a with low-back pain ^c (N)	Subjects ^b without low-back pain ^c (N)	Odds ratio	95% confidence interval
Age (years)				
<35	160	475	1 ^d	.
34–44	165	430	1.1	0.8–1.4
≥45	129	285	1.4	1.1–1.9
Gender				
Men	340	976	1 ^d	.
Women	114	214	1.3	0.9–1.8
Time driving/week (h)				
<10	39	153	1 ^d	.
10–14	105	273	1.5	1.0–2.4
15–19	106	360	1.2	0.8–1.9
20–24	121	254	2.0	1.3–3.1
≥25	83	150	2.1	1.3–3.4
Comfortable car seat				
Yes	350	1048	1 ^d	.
No	104	142	2.1	1.6–2.9
Carrying loads				
Yes	209	424	1.3	1.0–1.7
No	245	766	1 ^d	.
Standing				
Yes	243	532	1.3	1.0–1.6
No	211	658	1 ^d	.
Tobacco consumption				
Nonsmokers	168	499	1 ^d	.
Smokers + ex-smokers	286	691	1.4	1.1–1.7
Psychosomatic factors (sum)				
0	115	500	1 ^d	.
1 or 2	218	505	1.7	1.3–2.2
3 or 4	81	141	2.2	1.6–3.1
5 or more	40	44	3.3	1.9–5.4

^a N = 454.

^b N = 1190.

^c Nonrespondents not included.

^d Reference category.

Gender was also associated with low-back pain, with a higher risk among the women, but this result was not significant when other factors were taken into account. This finding does not disagree with the results of other authors (5, 8, 10, 13, 14).

Most of the other nonoccupational factors were not associated with low-back pain in our study. We did not find an association with marital status or educational level. Educational level has been found to be correlated with low-back pain in other studies (10, 11, 13, 14). The lack of this association in our study could be due to the fact that the educational level of our group was rather homogeneous. With regard to marital status, the results of various studies are not consistent (10, 11, 13, 14). Life-style factors associated with marital status could play a more important role than marital status per se. Although height (11, 14) and a 20% excess in relative weight (11) have been found to increase the risk of low-back pain, we did not find any association with height, weight, or the body mass index.

Of the nonoccupational factors significantly associated with low-back pain in the cross-sectional study, tobacco consumption showed a significantly elevated risk among current and ex-smokers compared with nonsmokers. This finding is coherent with those of other studies (6, 14, 21, 27). No obvious explanation has been found for this association, and it is not certain that tobacco consumption plays a causal role. The occupational factors associated with low-back pain in the cross-sectional study were the time per week spent driving, the comfort of the car seat, carrying loads, and standing. Kelsey and her co-workers found that the driving of motor vehicles was associated with an increased risk for developing acute herniated lumbar intervertebral disc (20, 21, 28). An association between driving vehicles and low-back pain was also shown by Walsh et al (8) and Damkot et al (19). For Walsh and his co-workers driving more than 4 h daily in the year prior to the onset of symptoms was found to be associated with the occurrence of low-back pain. The study of Damkot et al was cross-sectional, and no de-

Table 6. Unconditional odds ratios and relative risks for the one year cumulative incidence of low-back pain in the longitudinal phase of the study^a and the sociodemographic data, life-style, work environment, and psychosomatic factors in the cross-sectional phase of the study.

	Subjects ^b with low-back pain ^d (N)	Subjects ^c without low-back pain ^d (N)	Odds ratio	95% confidence interval	Relative risk
Age (years)					
<35	40	204	1 ^e	.	1 ^e
35–44	27	183	0.7	0.4–1.2	0.7
≥45	14	133	0.6	0.3–1.2	0.6
Gender					
Men	63	429	1 ^e	.	1 ^e
Women	18	91	1.5	0.8–2.9	1.5
Time driving/week (h)					
<10	3	71	1 ^e	.	1 ^e
10–14	20	119	4.0	1.1–14.3	3.6
15–19	31	154	4.8	1.4–16.4	4.2
20–24	16	115	3.3	0.9–12.0	3.1
≥25	11	61	3.7	0.9–14.0	3.3
Comfortable car seat					
Yes	65	467	1 ^e	.	1 ^e
No	16	53	1.9	1.0–3.7	1.9
Carrying loads					
Yes	30	194	0.9	0.5–1.5	0.9
No	51	326	1 ^e	.	1 ^e
Standing					
Yes	32	240	0.8	0.5–1.4	0.8
No	49	280	1 ^e	.	1 ^e
Tobacco consumption					
Nonsmokers	30	235	1 ^e	.	1 ^e
Smokers + ex-smokers	51	285	1.3	0.8–2.1	1.3
Psychosomatic factors (sum)					
0	31	233	1 ^e	.	1 ^e
1 or 2	33	225	1.1	0.6–1.8	1.0
3 or 4	15	47	2.5	1.2–5.1	2.3
5 or more	2	15	0.8	0.2–4.0	0.8

^a From the cross-sectional phase of the study (T_0) to 12 months thereafter.

^b Total number = 81.

^c Total number = 520.

^d Nonrespondents not included.

^e Reference category.

tails were given about the time spent driving. Mechanical stresses on the spine from the sitting posture and from vibration have been incriminated in this association. The prolonged sitting posture has been found to be associated with low-back pain (8, 28, 29), but no reference was made to the comfort of the seat. Because of the cross-sectional design of this part of the study, it was difficult to determine whether an uncomfortable seat was responsible for low-back pain or whether the subjects found their seat uncomfortable because of their back pain. In the literature, heavy lifting is one of the most constant factors associated with low-back pain (6–8, 18, 19). With regard to carrying loads, we found a significant increase in risk of the same magnitude among the men and the women. However, no details were available about the weight lifted. Prolonged standing also represented a slightly increased risk, and this finding is supported by those of other studies (7, 29). As has already been discussed, the direction of the association between these factors and low-back pain cannot be established from cross-

sectional data. Moreover, commercial travelers do not undergo very high levels of physical constraints.

Finally, a strong association with psychosomatic factors was observed, and corroborated by the trend in the odds ratios according to the magnitude of the disorders. Although there is some evidence of an association between low-back pain and psychological factors such as anxiety, depression, or hysteria, no consistent results emerge from the literature (30–32). Most studies on psychological factors and low-back pain have been carried out retrospectively, in which case it is not possible to conclude whether the psychological troubles are the cause or the consequence of low-back pain. A recent study using longitudinal data concluded that stress symptoms and musculoskeletal disorders are reciprocally related (33).

In the longitudinal part of the study, we attempted to determine which factors could be considered predictive of low-back pain. Except for age, carrying loads, and standing, the associations found for prevalence were also observed for incidence. The consistency of

our results at T_0 with those at T_1 is an argument in favor of a causal relation between low-back pain and some of the risk factors. For example, the number of hours spent driving and the comfort of the car seat remained risk factors and thus supported the hypothesis of driving as a causal risk factor of low-back pain. The results suggest that there could be a threshold limit for the incidence of low-back pain (10 h driving/week). The fact that a dose-response relationship with prevalence was observed could be coherent with the hypothesis that the duration of symptoms increases with the number of hours driven.

For the study on incidence, the risk factors were recorded at T_0 . If the risk factors have an effect without a latency period, it might be better to assess them immediately before the onset of the symptoms. The differences between these two ways of assessing exposure are probably not important, but they could have biased the odds ratios of our study toward unity.

Most of our results confirm those of other authors, especially concerning driving and psychological factors. Even if it is not possible to draw formal conclusions with regard to causal associations, the consistency of the results with time (at T_0 and T_1) and with findings reported in the literature indicate that these associations are probably not spurious. Further longitudinal studies are needed to confirm the causality so that preventive measures can be adopted in occupations at risk of low-back pain.

References

- Gepner P. Lombo-sciatiques (2): aspects médico-sociaux et médico-légaux. *Impact méd* 1989;38:17—9.
- Marty J. Quelques chiffres et réflexions sur les lombalgies. *Rhumatologie* 1989;41:61—4.
- Axelsson S. In Sweden back pain costs more than 5,000 million Swedish crowns a year. *Swed Inst Health Econ IHE Inf* 1988;September:1—3.
- Svensson HO, Andersson GBJ. Low back pain in forty to forty-seven year old men: I. frequency of occurrence and impact on medical services. *Scand J Rehabil Med* 1982;14:47—53.
- Biering-Sorensen F. Low back trouble in a general population of 30-, 40-, 50-, and 60-year-old men and women. *Dan Med Bull* 1982;29:289—99.
- Frymoyer JW, Pope MH, Clements JH, Wilder DG, MacPherson B, Ashikaga T. Risk factors in low back pain: an epidemiological survey. *J Bone Jt Surg* 1983;65-A:213—8.
- De Gaudemaris R, Blatier JF, Quinton D, et al. Analyse du risque lombalgique en milieu professionnel. *Rev Epidemiol Santé Publique* 1986;34:308—17.
- Walsh K, Varnes N, Osmond C, Styles R, Coggon D. Occupational causes of low-back pain. *Scand J Work Environ Health* 1989;15:54—9.
- Andersson GBJ. Epidemiologic aspects on low-back pain in industry. *Spine* 1981;6:53—60.
- Nagi SZ, Riley LE, Newby LG. A social epidemiology of back pain in a general population. *J Chronic Dis* 1973;26:769—79.
- Gyntelberg F. One year incidence of low back pain among male residents of Copenhagen aged 40—59. *Dan Med Bull* 1974;21:30—6.
- Heliövaara M, Impivaara O, Sievers K, Melkas T, Knekt P, Korpi J, et al. Lumbar disc syndrome in Finland. *J Epidemiol Community Health* 1987;41:251—8.
- Reisbord LS, Greenland S. Factors associated with self-reported back-pain prevalence: a population-based study. *J Chronic Dis* 1985;38:691—702.
- Leigh JP, Sheetz RM. Prevalence of back pain among fulltime United States workers. *Br J Ind Med* 1989;46:651—7.
- Magora A. Investigation of the relation between low back pain and occupation: 6. medical history and symptoms. *Scand J Rehabil Med* 1974;6:81—8.
- Brown JR. Factors contributing to the development of low back pain in industrial workers. *Am Ind Hyg Assoc J* 1975;36:26—31.
- Biering-Sorensen F. A prospective study of low back pain in a general population: I. occurrence, recurrence and aetiology. *Scand J Rehabil Med* 1983;15:71—9.
- Svensson HO, Andersson GBJ. Low-back pain in 40- to 47-year-old men: work history and work environment factors. *Spine* 1983;8:272—6.
- Damkot DK, Pope MH, Lord J, Frymoyer JW. The relationship between work history, work environment and low-back pain in men. *Spine* 1984;9:395—9.
- Kelsey JL, Hardy RJ. Driving of motor vehicles as a risk factor for acute herniated lumbar intervertebral disc. *Am J Epidemiol* 1975;102:63—73.
- Kelsey JL, Githens PB, O'Conner T, Weil U, Calogero JA, Holford TR, et al. Acute prolapsed lumbar intervertebral disc: an epidemiologic study with special reference to driving automobiles and cigarette smoking. *Spine* 1984;9:608—13.
- Les Forces de Vente. Relations Santé-Travail: Etude transversale. Paris: Centre d'Information des Services Médicaux d'Entreprises et Intereprises (CISME), 1990:120. (Document no 7/1990.)
- World Health Organization (WHO). International standard classification of occupations (ISCO—1968). Geneva: WHO International Labour Office, 1988:415.
- Langner TS. A twenty-two item screening score of psychiatric symptoms indicating impairment. *J Health Hum Behav* 1962;3:269—276.
- Engelman L. Stepwise logistic regression. In: Dixon WJ, ed. *BMDP statistical software manual*. Berkeley, CA: University of California Press, 1985:330—44.
- Mechanic D, Angel RJ. Some factors associated with the report and evaluation of back pain. *J Health Soc Behav* 1987;28:131—9.
- Svensson HO, Vedin A, Wilhelmsson C, Andersson GBJ. Low-back pain in relation to other diseases and cardiovascular risk factors. *Spine* 1983;8:277—85.
- Kelsey JL. An epidemiological study of the relationship between occupations and acute herniated lumbar intervertebral discs. *Int J Epidemiol* 1975;4:197—205.
- Magora A. Investigation of the relation between low back pain and occupation: 3. physical requirements: sitting, standing and weight lifting. *Ind Med Surg* 1972;41:5—9.
- McCreary C, Turner J, Dawson E. Differences between functional versus organic low back pain patients. *Pain* 1977;4:73—8.
- Tsushima WT, Towne WS. Clinical limitations of the low back scale. *J Clin Psychol* 1979;35:306—8.
- Crown S. Psychosocial factors in low back pain. *Clin Rheum Dis* 1980;6:77—92.
- Leino P. Symptoms of stress predict musculoskeletal disorders. *J Epidemiol Community Health* 1989;43:293—300.

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