Prevalence, incidence, and recurrence of low back pain in scaffolders during a three year follow-up study

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Abstract

Study design: Prospective cohort study.

Objective: To describe the natural history of low back pain by its prevalence, incidence, and recurrence during a 3 year period and identify risk factors for cumulative incidence and recurrence of low back pain in scaffolders.

Summary of background data: Although some studies have described either prevalence, incidence, or recurrence of low back pain, few studies have assessed two or more of these outcome measures simultaneously. Furthermore, little is known about the association between individual, physical, psychosocial, and health-related risk factors and cumulative incidence and recurrence of low back pain in scaffolders.

Methods: Between 1998 and 2001, a cohort of 288 scaffolders (response 85%) completed a questionnaire at baseline and at 3 yearly follow-ups during 3 years.

Results: At baseline 60% of the study population had had an episode of low back pain in the past 12 months of which 22 % was of chronic nature. During follow-up the yearly incidence of low back pain varied between 20%-28%, while yearly recurrence rates were 64% to 77%. Only few workers consistently reported the presence (20%) or absence (26%) of low back pain each year. Weak significant associations were present for age 35-44 years, moderate general health, high strenuous arm movements, and body mass index with the cumulative incidence of low back pain. Significant associations were found between high manual handling of material and high job demand and low job control and the cumulative recurrence of low back pain, while moderate general health only showed a weak significant association with this outcome measure.

Conclusions: Low back pain was a dynamic process with high rates for incidence, recurrence, and recovery. General health and work-related physical and psychosocial factors influenced both the incidence and recurrence of low back pain. The incidence and recurrence of low back pain depend strongly on the recall period of low back pain and the time-window of investigation.

Key points:

- In a longitudinal study the dynamics of low back pain in a working population are characterised by high rates of incidence and recurrence at consecutive yearly measurements.
- The incidence and recurrence of low back pain depend highly on the duration of the recall period and the time-window of investigation. Hence, the difference between incident and recurrent cases often arises by chance due to differences in time-window of investigation.
- Despite differences in definition between the cumulative incidence and recurrence of low back pain, both outcome measures were associated with risk factors of psychosocial, physical, and health related origin.

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Mini abstract

A prospective cohort study was conducted to assess prevalence, incidence, and recurrence of low back pain in scaffolders. Cumulative incidence and recurrence of low back pain were both associated with psychosocial, physical, and health-related risk factors. Incidence and recurrence depend strongly on the recall period and time-window of investigation.

Introduction

Low back pain is a common condition comprising a major health problem worldwide. It will eventually affect almost everyone in life, men and women equally.[20] The lifetime prevalence of low back pain is estimated at 60-85%,while the annual prevalence in the general population is ranging from 15-45%.[4,10,16] The annual incidence of back pain in the general population is estimated between 10%-15%.[3] In the vast majority of patients low back pain is a self limiting condition, from which 90% are expected to recover in about six weeks.[41] However, high recurrence rates of 40-70%, including annual recurrence rates of 60% have been reported.[6,12]

Results from various studies on prevalence, incidence, and recurrence of low back pain are difficult to compare, often due to differences in the period of recall.[7] A complicating factor in low back pain research is the fact that onset and duration of low back pain episodes are difficult to measure. For example, if the time of onset of LBP is not clearly defined, it is very difficult to distinguish between incidence and recurrence.[9] Surprisingly few studies have assessed at least two outcome measures at the same time within the same population.[11,13,21]

Acknowledging that prevalence, incidence, and recurrence are dynamic entities which can change over time, there is a clear need for longitudinal studies that describe the dynamic pattern of low back pain episodes over time. In this article, we present the results of a longitudinal study with a long follow-up period. The objective of this study was (a) to assess prevalence, incidence, and recurrence of low back pain in a working population, (b) to describe the changing occurrence of low back pain in a longitudinal study and (c) to investigate which risk factors were associated with incidence and recurrence of low back pain during the three year follow-up period.

Subjects and methods

Study population

Subjects were selected from a scaffolding company since the job of scaffolding is noted for its high occurrence of low back pain.[17] The principal tasks of scaffolders are erecting and taking down large scale scaffolds. During these tasks, manual handling of material is one of the most dominant activities due to lifting, lowering, and carrying of heavy materials such as scaffolding poles and boards, guard rails, and ladders. In total, 337 subjects were invited to participate in the study. In this longitudinal study data were gathered on a yearly basis during a three year follow-up.

Questionnaire

Between June and November 1998, a baseline questionnaire was administered by interviewing 337 scaffolders. The initial response was 85% (n=288). All responders in the baseline (n=288) were sent consecutive questionnaires during 3 follow-up periods, provided that they were still working in the scaffolding company. The questionnaire on musculoskeletal disorders was derived from the standard Nordic questionnaire.[24] The questionnaire collected personal data, details on the respondent's job and employment history, health status, leisure time, the presence or absence of symptoms of low back pain and data on physical, psychosocial, and individual risk factors. Questions on physical work-load concerned manual handling of material such as lifting and carrying heavy loads, awkward working postures in which the back is bent and twisted, and strenuous arm movements such as working with hands above shoulder level.[17]

The questions on psychosocial aspects were derived from the Karasek model.[22] In this model subjects are supposedly at risk when experiencing high job demands and low job control. Job demands were measured by 11 questions with a four point scale, yielding a sum score for high work demands. Low job control was measured by six questions on skills and 11 questions on authority to make decisions. Information on individual risk factors such as age, height, and weight was also derived from the standard Nordic questionnaire. The body mass index was calculated by dividing self-reported weight (kilograms) by the square of the height (meters) using a cut-off point of 27 or more.

In the questionnaire a measure of general health was included. Perceived general health was measured by 13 dichotomised questions about the workers health representing the actual health situation and was rated according to the VOEG scale with a good internal scale reliability (Crohnbach's α=0.86) and test-retest reliability (Pearson's r=0.76).[39]

Two end points of low back pain were defined: (a) low back pain in the past 12 months referred to at least one episode of low back pain in the past 12 months for at least a few hours, and (b) chronic low back pain in the past 12 months referred to low back pain which was present almost every day in the preceding 12 months with a minimal presence for at least 3 months. The last definition is a subgroup of the first one. A detailed description of the questionnaire has already been published elsewhere.[17]

Definitions

In this study we used the following definitions for prevalence, incidence, recurrence, and recovery. Low back pain was defined as a person who experienced an episode of pain, stiffness, or discomfort of the lower back.[24] A prevalent case was defined as a subject having had at least one episode of low back pain during the previous 12 months. These cases were determined during baseline survey, follow-up 1, follow-up 2, and follow-up 3. An incident case was defined as a new episode of low back pain during 12 months after at least a period of one year free of low back pain. Thus, incident cases could be identified during follow-up 1, follow-up 2, and follow-up 3. The cumulative incidence was defined as all cases with a new episode of low back pain during the 3 year follow-up among those without low back pain at baseline.

Recurrence was defined as an episode of low back pain in a given year subsequent to a previous year with similar complaints. Hence, the 12 months recurrence implied two consecutive years of low back pain and could be recorded during follow-up 1, follow-up 2, and follow-up 3. For the cumulative recurrence, cases were obliged to have at least one episode of low back pain during follow-up and were found among those who suffered from low back pain at baseline. Given these definitions, a subject was regarded as recovered when a year with complaints was followed by a year free of complaints. Similar definitions on prevalence, incidence, and recurrence were also applied for chronic low back pain.

Statistical analysis

The statistical analysis was based on Generalized Estimating Equations (GEE).[30] In the GEE-model all risk factors and covariates were assumed to be time-independent, which means that only information on risk factors from the baseline measurements were used like in conventional regression analysis. These risk factors at baseline were related to low back pain reported in follow-up 1, follow-up 2, and follow-up 3, using two endpoints: cumulative incidence and cumulative recurrence of low back pain. All subjects who responded at least once were included in the analysis, whereas subjects were excluded from the cohort at the time when they left the scaffolding company.

In the statistical analysis low back pain was the dependent variable. Chronic low back pain could not serve as a dependent variable due to small numbers. Since age appears to influence strongly the probability of musculoskeletal symptoms like low back pain, it was included in each model, regardless of its level of significance. In the univariate analysis odds ratios (OR) with 95% confidence intervals were calculated for the risk factors studied. For the initial selection of variables in the univariate models a significance level of $p<0.10$ was used. In the final multivariate model variables with a p-value of 0.10 or less were retained, taking into account the size of the study population. Calculations were carried out with Proc Genmod in the statistical package SAS (Version 6.12).[35]

Results

Response

The total cohort consisted of 288 workers at baseline, 209 (73%) at first follow-up, 182 (63%) at second follow-up, and 144 (50%) at third follow-up. The majority of workers responded to each questionnaire during the study. The cohort of workers with complete data during all 4 measurements consisted of 288 at base-line (response 85%), 209 workers at first follow-up (response 73%), 163 workers at second follow-up (response 78%) and 127 workers at third follow-up (response 78%).

In this cohort with complete data 49% (n=79) of the non-respondents during the first follow-up changed jobs and left the company. During the second and third follow-up this was 43% (n=46) and 33% (n=36), respectively. Another 10%, 11%, and 22% of the non-respondents entered the permanent disability scheme, with over 50% of these cases due to musculoskeletal disorders. During the first follow-up non-respondents reported a higher prevalence of low back pain in the baseline survey than respondents, 67% versus 57%, but this difference was not statistically significant.

Prevalence, incidence, and recurrence

Epidemiological data of low back pain and chronic low back pain in the past 12 months are presented in table 1. The prevalence in the baseline was 60% for low back pain and 22% for chronic low back pain in the past 12 months. The prevalence during three year follow-up varied between 44% and 46% for low back pain and between 10% and 12% for chronic low back pain. During the three year follow-up, the yearly incidence for low back pain was 20% to 28%.

The yearly incidence for chronic low back pain varied between 4 and 7%. Recurrence of low back pain was 65%, 77%, and 64% in the first, second, and third follow-up respectively. Recurrence for chronic low back pain varied between 33% and 65%.

The cumulative incidence of low back pain during the three year follow-up period was estimated as 37 (39%) out of 96 subjects free of low back pain at baseline. The cumulative recurrence of low back pain during the same period was 104 (78%) out of 133 subjects with low back pain at baseline.

Table 1 Prevalence, incidence, and recurrence of low back pain in the past 12 months and chronic low back pain in the past 12 months during a 3 year follow-up period among scaffolders

Respons	Baseline 95% CI (n=288)	1st follow-up 95% CI (n=209)	2nd follow-up 95% CI (n=163)	3rd follow-up 95% CI (n=127)
LBP past 12 months				
Prevalence	60% (54 - 65%)	46% (39 - 52%)	46% (38 - 54%)	44% (36 - 49%)
Incidence	--	20% (15 - 25%)	21% (15 - 27%)	28% (21 - 36%)
Recurrence	--	65% (58 - 71%)	77% (70 - 83%)	64% (56 - 72%)
Chronic LBP past 12 months				
Prevalence	22% (17 - 27%)	11% (7 - 15%)	10% (6 - 15%)	12% (6 - 17%)
Incidence	--	5% (2 - 8%)	4% (1 - 7%)	7% (3 - 12%)
Recurrence	--	33% (27 - 40%)	65% (57 - 72%)	58% (50 - 67%)

95% CI = 95% confidence interval
LBP: low back pain

Dynamic pattern of low back pain over time

The trajectories of individual workers during the 4 consecutive measurements are shown in table 2. In total, 127 persons were included who responded both at baseline and at every follow-up. Only 26 (20%) out of 127 subjects consistently reported low back pain during each year of follow-up (trajectory 1), and only 33 (26%) out of 127 subjects consistently reported the absence of low back pain (trajectory 16). During the 4 year period 94 out of 127 subjects (74%) experienced at least one episode of low back pain.

Table 2 Individual trajectories of low back pain cases during 4 consecutive measurements among 127 persons working in a scaffolding company

Trajectory	Baseline	Follow-up 1	Follow-up 2	Follow-up 3	Number of cases
1	+	+	+	+	26
2	+	+	+	-	7
3	+	+	-	+	6
4	+	+	-	-	6
5	+	-	+	+	5
6	+	-	+	-	7
7	+	-	-	+	4
8	+	-	-	-	14
9	-	+	+	+	3
10	-	+	+	-	4
11	-	+	-	+	1
12	-	+	-	-	1
13	-	-	+	+	1
14	-	-	+	-	3
15	-	-	-	+	6
16	-	-	-	-	33

Risk factors

Table 3 presents the results of the univariate analysis on risk factors for both cumulative incidence and recurrence of low back pain during the three year follow-up period. Considering cumulative incidence, moderate general health showed a significant association with low back pain. Some indication for a potential association was found for high body mass index, whereas high strenuous arm movements, high awkward back posture, and high job demand and low job control were elevated but did not reach statistical significance. High manual handling of materials, high job demand and low job control and moderate general health were found to be significant risk factors for the cumulative recurrence of low back pain. High awkward back posture showed a weak significant association and no significant associations were found for high strenuous arm movements and high body mass index.

Table 4 shows the results from the multivariate analysis with Generalised Estimating Equations (GEE) of risk factors for the cumulative incidence and recurrence of low back pain during the three year follow-up period. Weak significant associations were found for age 35-44, moderate general health, high strenuous arm movements, and high body mass index with the risk on incidence of low back pain.

In the multivariate analysis for cumulative recurrence of low back pain significant risk factors were high manual handling of materials and high job demand and low job control. Moderate general health showed a weak significant association with this outcome measure.

Table 3 Risk factors, adjusted for age, for cumulative incidence and cumulative recurrence of low back pain during a 3 year follow-up period among scaffolders (univariate analysis)

Risk factors	n (%)	Odds Ratio	95% confidence interval
Cumulative incidence (n=96)			
High manual handling of materials	40 (42%)	1.05	0.49 - 2.27
High strenuous arm movements	49 (51%)	1.93	0.84 - 4.45
High awkward back posture	35 (37%)	1.47	0.68 - 3.19
High job demand and low job control	13 (14%)	2.24	0.77 - 6.53
Moderate general health*	24 (25%)	2.37	1.03 - 5.47
High body mass index	35 (37%)	2.00	0.91 - 4.39
Cumulative recurrence (n=133)			
High manual handling of materials*	77 (58%)	2.14	1.17 - 3.89
High strenuous arm movements	75 (56%)	1.34	0.73 - 2.46
High awkward back posture	66 (50%)	1.73	0.97 - 3.08
High job demand and low job control**	43 (32%)	2.58	1.37 - 4.87
Moderate general health*	66 (50%)	1.99	1.11 - 3.56
High body mass index	50 (38%)	1.09	0.60 - 2.00

* significant, p<0.05 | ** significant, p-value 0.01

Table 4 Multivariate analysis of risk factors for cumulative incidence and cumulative recurrence of low back pain during a 3 year follow-up period among scaffolders

Risk factors		n (%)	Odds Ratio	95% confidence interval
Cumulative incidence (n=96)				
Age	< 35	46 (48%)	1.00	
	35-44 years	29 (30%)	2.22	0.90 - 5.46
	> 45	21 (22%)	0.68	0.24 - 1.92
Moderate general health		42 (44%)	2.27	0.99 - 5.19
High strenuous arm movements		49 (51%)	2.11	0.96 - 4.66
High body mass index		35 (36%)	1.97	0.91 - 4.27
Cumulative recurrence (n=133)				
Age	< 35	62 (46%)	1.00	
	35-44 years	41 (31%)	1.03	0.51 - 2.10
	> 45	30 (23%)	1.50	0.69 - 3.28
Moderate general health		66 (50%)	1.76	0.98 - 3.17
High manual handling of materials*		77 (58%)	2.02	1.12 - 3.66
High job demand and low job control*		43 (32%)	2.16	1.12 - 4.21

* significant, p<0.05

Discussion

The purpose of this longitudinal study was to assess the dynamics of low back pain by analysing prevalence, incidence, and recurrence of low back pain and associated risk factors in a population of scaffolders. The results of this study showed that the prevalence of low back pain was high at baseline and fairly consistent during follow-up. While the incidence showed some increase, the recurrence varied largely during the same period. Recurrence of low back pain exceeded both prevalence and incidence at all times during follow-up. There were some indications for a potential association between physical and health-related factors and the cumulative incidence of low back pain, while physical and psychosocial factors showed significant associations with the cumulative recurrence of low back pain.

The prevalence, incidence, and recurrence of low back pain will change over time, depending on the chosen time-window. By studying these measures longitudinally within a cohort of scaffolders the natural course of low back pain becomes apparent (table 1). At baseline the prevalence of low back pain and chronic low back pain in the past twelve months was 60% and 22%, respectively, which is comparable with findings in the literature.[31,33,34,37] The prevalence rates dropped slightly, eventually reaching a steady state during follow-up, which is in accordance with results from other studies. [29,32] An explanation for this drop in prevalence rate could be a selection mechanism in which those with a poor health were forced to leave the company, either voluntarily or because of disability. The analysis of non-response illustrated that 10%-22% of the non-response was health-related due to subjects becoming permanent disabled, often due to musculoskeletal disorders. This may have led to an unterestimation of the prevalence of low back pain in the subsequent follow-ups of a few percent. The voluntary non-response was primarily due to subjects leaving the company for other work. Only in the first follow-up year there was some indication that those who left had a higher baseline prevalence of low back pain than those who continued in their job. This supports the assumption that a healthy worker effect might have been present.[17] Another explanation could be the method by which the questions were presented.[7] At baseline, the questionnaires were primarily administered by interview. In the three year follow-up period the self-administered questionnaires were sent and returned by mail. Hence, during the baseline survey the interviewer could have influenced the answers of the workers interviewed.[29]

The incidence rates for both low back pain and chronic low back pain in the past 12 months showed similar features (table 1). Although there was a slight, non-significant increase in the third follow-up, incidence rates were fairly constant over the consecutive follow-up periods, as would be expected.[32] The incidence rates of low back pain in the past 12 months of 20-28% are comparable with incidence rates in transit drivers and construction workers, including scaffolder.[23,25]

The one-year recurrence rate of 64%-77% for low back pain in the past 12 months is in the range of results from other studies.[5,6] The low recurrence rate of chronic low back pain in the first follow-up could be the result of a high dropout of disabled scaffolders during the first year of follow-up, rendering a fairly healthy population at work.

The variability of recurrence of low back pain during the three year follow-up depends also on the high recovery rates. In case of high incidence rates, high recurrence and recovery rates will be inevitable, since otherwise prevalence rates would eventually be 100% within four to five years.

Table 2 demonstrates the trajectories of low back pain during 4 consecutive measurements. Subjects showed remarkable differences in low back pain status during the follow-up. The trajectories illustrate the problem of defining incidence and recurrence.

For example, trajectory 6 and 11 have a similar pattern over a four year period (table 2), but cases will be defined differently depending on the start of the study. In longitudinal studies it is to some extent arbitrarily to define subjects at baseline as either prevalent or low back pain free. Consequently, during the follow-up it will also be arbitrarily to distinguish incident cases from recurrent cases since a longitudinal study starting one year later would define many incident cases as recurrent cases and vice versa. Considering the association with various risk factors of low back pain, it may imply that in studies on incidence and recurrence of low back pain risk factors should be similar.[2,11,14,15,19,23,26,36]

Due to the dynamic nature of low back pain and because of the fact that most workers will have had a previous episode of low back pain sometimes in their lives, it is far from easy to determine when a given episode of low back pain is independent from a previous episode or not. Hence, incident and recurrent episodes might not be as independent as their definitions suggest.[1] In fact, previous episodes of low back pain as a risk factor are an expression of the probability of recurrence of low back pain and, therefore, should not be included into a risk model as an independent risk factor. The finding of the association between previous episodes of low back pain and recurrence of low back pain might even be tautological, since for almost any subject having had a previous episodes of low back pain recurrence of low back pain will be inevitable. However, it would be of much more interest to assess if people without pre-existing low back pain were as likely as those having had pre-existing low back pain to show recurrence and recovery of low back pain within a certain time-window.

The definitions of incidence and recurrence are strongly determined by the time-window of recall. In our study we used a time-window of one year. A disadvantage of this time-window is its length in which for instance, incident cases could have had recurrent spells of low back pain, thus increasing the variability of individual trajectories.[40] It will not be easy to adapt internationally excepted definitions for either outcome measure, although research would benefit from more strict definitions. In order to broaden the insight into the variability of low back pain, it may be advisable to study incidence and recurrence simultaneously. Another alternative could be to study the frequency of low back pain in a certain time-window rather than defining the occurrence of low back pain in consecutive time-windows. Finally, in order to describe the dynamics of low back pain, it may be required to study aggravation in relation to various risk factors and interventions.[8,18,38]

The results of the analysis on risk factors for the cumulative incidence and recurrence of low back pain showed some variation in importance of the risk factors (table 3 and 4). Due to the fact that high manual handling of materials, high awkward back posture, and high strenuous arm movements, were strongly interrelated, it was to some extent arbitrarily which physical risk factor would reach significance.[17] However, the results are in accordance with findings from the literature in which workers performing heavy physical work have an increased risk of a new episode of low back pain.[11,36] The same is applicable to psychosocial risk factors but due to small numbers high job demand and low job control (OR 2.24, 95% CI 0.77-6.53) in table 3 lacked a significant association with cumulative incidence of low back pain.[2,23]

Moderate general health was associated with both incidence and recurrence of low back pain (table 3 and 4). It can be hypothesised that a poor health status makes a worker more vulnerable for a new episode of low back pain.[14] The finding that body mass index (OR 2.00, 95% CI 0.91-4.[39]) showed a weak significant association with cumulative incidence of low back pain is supported by results from a systematic review.[27] However, in a cross-sectional study a positive association was found between body mass index and low back pain that increased with the duration of low back pain, suggesting it to be more important in case of chronic or recurrent low back pain.[28]

In conclusion, this is one of the first longitudinal studies in which prevalence, incidence, and recurrence of low back pain were studied simultaneously. The annual incidence of low back pain varied between 20% -28% while annual recurrence rates were 64% to 77%. Only few workers consistently reported the presence (20%) or absence (26%) of low back pain each year. Results showed that, independent of the outcome measure, and with some shift in accent, psychosocial, physical, and health-related risk factors were associated with both the cumulative incidence and recurrence of low back pain. One has to bear in mind that this study was limited to scaffolders, with a known high level of physical work load, and this may restrict generalizability to other occupational populations. The variability in trajectories of low back pain within a certain time-window has illustrated that low back pain is a dynamic entity. This study also showed that it is imperative to consider definitions of prevalence, incidence, and recurrence of low back pain to match the chosen time-window, in order to better understand the natural course of self-reported low back pain in a working population.

References

1. Abenhaim L, Suisa S, Rossignol M. Risk of recurrence of occupational back pain over three year follow up. Brit J Ind Med 1988;45:829-833.
2. Adams MA, Mannion AF, Dolan P. Personal risk factors for first-time low back pain. Spine 1999;23: 2497-2505.
3. Anderson GBJ. Epidemiology features of chronic low-back pain. Lancet 1999;354:581-85.
4. Anderson GBJ. The epidemiology of spinal disorders. In: Frymoyer JW, editor. The adult spine: principles and practice, 2nd edition. New York: Raven Press 1997:93-141.
5. Bergquist-Ullman M, Larsson U: Acute low back pain in industry. Acta Orthop Scand 1977:1-170.
6. Biering-Sørensen F. A prospective study of low-back pain in a general population. Occurrence, recurrence and aetiology. Scand J Rehabil Med 1983;15:71-79.

7. Biering- Sørensen F, Hilden J. Reproducibility of the history of low back trouble. Spine 1984;9: 280-86.
8. Burdorf A, Rossignol M, Fathallah FA et al. Challenges in assessing risk factors in epidemiogic studies on back disorders. Am J Ind Med 1997;32:142-152.
9. Burdorf A, Van der Beek A. Exposure assessment strategies for work-related risk factors for musculoskeletal disorders. Scand J Work Environ Health 1999;25(suppl 4):25-30.
10. Burton AK, Clarke RD, Mc Clude TD et al. The natural history of LBP in adolescents. Spine 1996;21:2323-28.
11. Burton AK, Tillotson KM, Symonds TL et al. Occupational risk factors for the first onset and subsequent course of low back trouble. A study of serving police officers. Spine 1996;21:2612-20.
12. Clinical standards Advisory Group. Epidemiology review: the epidemiology and cost of low back pain. London: HMSO;1994.
13. Croft PR, Macfarlane GJ, Papageorgiou AC et al. Outcome of low back pain in general practice a prospective study. BMJ 1998;316:1356-59.
14. Croft PR, Papageorgiou AC, Thomas E et al. Short-term physical risk factors for new episodes of low back pain. Prospective evidence from the South Manchester back pain study. Spine 1999;24: 1556-61.
15. Devereux, JJ, Buckle PW, Vlachonikolis G. Interactions between physical and psychosocial risk factors at work increase the risk of back disorders: an epidemiological approach. Occup Environ Med 1999;56:343-53.
16. Deyo RA. Nonsurgical care of low back pain. Neurosurgical clinics of North America. 1991;2:851-62.
17. Elders LAM, Burdorf A. Interrelations of risk factors of low back pain in scaffolders. Occup Environ Med 2001;58:597-653.
18. Elders LAM, Van der Beek AJ, Burdorf A. Return to work after sickness absence due to back disorders - a systematic review on intervention strategies. Int Arch Occup Environ Health 2000;73:339-48.
19. Feyer AM, Herbison P, Williamson AM et al. The role of physical and psychological factors in occupational low back pain: a prospective cohort study. Occup Environ Med 2000; 57:116-120.
20. Frymoyer JW. Back pain and sciatica. N Engl J Med 1988;318:291-300.
21. Garcy P, Mayer T, Gatchel RJ. Recurrent or new injury outcomes after return to work in chronic disabling spinal disorders. Tertiary prevention efficacy of functional restoration treatment. Spine 1996;21:952-59.
22. Karasek RA, Baker D, Marxer F. Job decision latitude, job demands and cardiovascular disease: a prospective study among Swedish men. Am J Public Health 1981;71:694-705.
23. Krause NK, Ragland DR, Fischer JM et al. Psychosocial job factors, physical workload and incidence of work-related spinal injury: A 5 year prospective study of urban transit operators. Spine 1998;23:2507-16.
24. Kuorinka I, Jonsson B, Kilbom A et al. Standard Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon 1987;18:233-37.
25. Latza U, Karmaus W, Stürmer T. Cohort study of occupational risk factors of low back pain in construction workers. Occup Environ Med 2000;57:28-34.
26. Latza U, Pfahlberg A, Gefeller O. Impact of repetitive manual materials handling and psychosocial work factors on the future prevalence of chronic-low back pain among constructions workers. Scand J Work Environ Health 2002;28:314-23.
27. Leboeuf-Yde C. Body weight and low back pain. A systematic literature review of 56 journal articles reporting on 65 epidemiologic studies. Spine 2000;25:226-37.
28. Leboeuf-Yde C, Kyvik KO, Bruun NH. Low back pain and lifestyle.Part II-Obesity. Information from a populations-based sample of 29,424 twin subjects. Spine 1999;24:799-84.
29. Leino PI, Berg MA, Puska P.Is back pain increasing? Results from national surveys in Finland during 1978/9-1992. Scand J Rheumatol 1994; 23:269-76.
30. Liang K-Y, Zeger SL. Longitudinal data analysis using generalized linear models. Biometrika 1986;73:13-22.
31. Miedema HS, Chorus AMJ, Wevers CWJ et al. Chronicity of back problems during working life. Spine 1998;23:2021-29.

32. Murphy PL, Volinn E. Is occupational low back pain on the rise? Spine 1999; 24:691-97.
33. Papageorgiou AC, Croft PR, Ferry S et al. Estimating the prevalence of low back pain in the general population. Evidence from the South Manchester back survey. Spine 1995;20:1889-94.
34. Rothenbacher D, Breneer H, Arndt V. et al. Disorders of the back and spine in construction workers: prevalence and prognostic value for disability. Spine 1997;22:1481-86.
35. SAS Institute Inc. SAS/STAT® Software: Changes and enhancements through release 6.12. Cary, NC: SAS institute Inc,1997.
36. Smedley J, Egger P, Cooper C et al. Prospective cohort study of predictors of incident low back pain in nurses. BMJ 1997;314:1225-28.
37. Stürmer T, Luessenhoop S, Neth A, et al. Construction work and low back disorders. Preliminary findings of the Hamburg construction worker study. Spine 1997;22:2558-63.
38. Tousignant M, Rossignol M, Goulet L et al. Occupational disability to back pain: application of a theoretical model of work disability using prospective cohorts of manual workers. Am J Ind Med 2000;37:410-22.
39. Van Sonsbeek JLA. The Voeg. A list of subjective health complaints. The Hague: SDU Publishers, 1990 (statistical reports M37).
40. Von Korff M. Studying the natural history of back pain. Spine 1994;19:2041S-46S.
41. Waddell G.A. New clinical model for the treatment of low-back pain. Spine 1987;12:632-44.