

The cost of low-back pain: a review of the literature

Philip Jacobs, PhD, CMA
Department of Public Health Sciences
University of Alberta

Kamran Golmohammadi, MD
Institute of Health Economics
Edmonton, Alberta

Prepared for the Health Services Utilization and Outcomes Commission of Alberta

Date: March 19, 2003

Low-back pain is defined as tiredness, discomfort, or pain in the low back region, with or without radiating symptoms to the leg or legs (Danish Institute for HTA, 1999).

Low-back pain is a condition which usually begins at working age. It is a very widespread condition. In 1999 in Alberta, 17 per cent of persons between the ages of 20 and 39, and 20 per cent of persons between the ages of 40 and 49 reported having low-back pain (Statistics Canada, National Population Health Survey 1999, Public use database). In 2001 in Alberta, out of a total of 37,927 work loss claims, 26.8 per cent were associated with low-back pain (Alberta Human Resources and Employment, Occupational injuries and diseases in Alberta, 2001 Summary, July 2002, Table 4.3).

Low-back pain is also a very costly condition, in large part because it is associated with time off from work. In a U.S. based survey by Andersson et al., (1991) the overall annual cost per case varied from \$3,000 to \$6,600. Roughly one – third of these costs were incurred for medical expenses, and two-thirds were due to disability. In a widely quoted US study conducted for the American Academy of Orthopedic Surgeons in 1984, Grazier et al. (1984) stated that the annual costs of low-back pain were over \$16 billion. There is no more recent U.S. or Canadian statistics, but these estimates do indicate the large order of magnitude of the problem.

These statistics, however impressive, are only relevant if something can be done to reduce this total number, without harming the health related quality of life of persons who suffer from low-back pain. There is, at present, a wide range of comparative studies that have been conducted, and which include estimates on the cost of low-back pain. Reviews of these studies have been conducted by Manga et al. (1993) and Goossens et al. (1998). These comparative studies are of varying quality and focus, and tell us very different things. Despite the wide variation in study methods and quality, it is possible to obtain some very pertinent information on alternative courses of action used to prevent, diagnose, and treat low-back pain, and on their costs.

The purpose of this report is to provide a review of the studies which reported on the comparative costs of alterative modes of care in the prevention, diagnosis and treatment of low-back pain. The focus of our review is not on “what does low-back pain cost” since this will vary depending on a wide range of circumstances, and it does not provide a policy maker enough information that is helpful in making a decision. Our focus is on comparative information which can be useful for a policy maker, especially when used in conjunction with health outcome data.

Methods

Given the popularity of the subject, the literature on low-back pain costs is very diverse in subject and method. In order to obtain a comprehensive picture of the literature, we initially conducted a search of the

literature using the PUBMED data base. In our initial strategy we searched the data base for titles and abstracts which contained the key words “cost”, “cost effectiveness,” and “economic evaluation” coupled with “low-back pain”. We searched the abstracts of all these papers for studies which reported on the costs of comparative interventions. For each citation identified, we searched the PUBMED database for similar articles. We then searched the bibliographies of the retained articles for further references. We searched the web for additional studies, including those not published (the gray literature). We included all studies which reported alternatives and measured the costs of these in our initial analysis; however we then excluded a number of studies because of incomplete reporting. We abstracted the retained articles. In our abstraction we focused on a number of separate criteria.

The major diagnosis whose costs we analyzed was “low-back pain”. Low-back pain is a very broad term, and covers a number of separate conditions (New Zealand Accident Rehabilitation and Compensation Insurance Corp., 1997; Danish Institute for Health technology Assessment, 1999). In particular, there is a difference between acute and chronic low-back pain, and more serious conditions such as nerve root damage (Nyiendo, 1991, Part I). These were not always clearly delineated in the studies; indeed, some of the decisions made by analysts resulted in biased measures of the cost differences between interventions. For example, a small number of low-back pain cases (often surgically treated) are serious and very high cost; Hashemi et al. (1997) have shown that seven per cent of these severe cases account for a large portion (75%) of the total cost of low-back pain care. In a study which compared chiropractic and medical treatments, some analysts dropped all cases in which patients crossed over to the other intervention. Eventually, some of these high severity cases would end up with high cost surgery. If they are excluded only from the chiropractic arm of the study, then the cost of those choosing chiropractic care relative to care from medical doctors would be underestimated.

We organized the interventions into three groups (Cats-Baril and Frymoyer, 1991; Goossens and Evers, 1997): these are (1) injury prevention interventions, such as back schools and ergonomic programs; (2) early diagnostic measures such as the routine use of X-Rays; (3) post injury treatment and management programs, including active treatment, pain management, and return- to- work programs. Goossens and Evers (1997) divide the third category into two components, post incidence management programs (designed to get the patient back to work) and injury and pain remediation. While these perform different functions, we found that both were often included in a single alternative course of action, and so we could not clearly separate and cost them; as well, it would be very difficult to separate out their health outcomes.

We classified the study type by determining if the interventions fell into one of two major groups – experimental and actual. For our purposes, an experimental study is defined as one in which the design of the key interventions are pre-specified by the investigator. An actual study is one in which the interventions are not pre-designed. An experimental study that is a randomized control study (RCT) will provide

unbiased information on the difference in resource use and cost between two or more interventions. However, the interventions, in addition to being pre-designed, may be more closely monitored in the experimental study than would normally be the case, and so patient compliance will not be the same. A study of actual practice will therefore provide a better picture of resource use for policy makers. We should note that there are some studies which are experimental, but which randomize patients to two or more actual interventions; one such study, comparing chiropractic and outpatient hospital outcomes for low-back pain, was conducted by Meade et al. (1990).

We classified the studies according to their time horizon. Many low-back pain episodes last for years and according to the economic evaluation guidelines developed by the Canadian Coordinating Office for Health Technology Assessment (CCOHTA) (1997), all of the relevant downstream (long range) effects of an intervention should be measured. We noted a wide range of timelines in the studies. The observation period can have a considerable effect on the patient's cost, even when these measures are standardized. We will comment on these where appropriate. We standardized these costs by reporting results in terms of cost per month.

A costing study should include all of the relevant services associated with the treatment of low-back pain. These include practitioner services (physicians, chiropractors, and physiotherapists), hospital care, medicines, outpatient hospital care, long term nursing care and home care, as well as the care of alternative treatments performed. The study should also include the costs of any prevention or screening programs, such as back schools. A study of a preventive program, therefore, should also include the routine treatment costs associated with back care in addition to program costs. We identified the services which were included in each study; these varied considerable from study to study, and in most cases the services were not broken down into categories. It was therefore very difficult to make comparisons of treatment costs between studies. Unless otherwise noted, the cost per day includes hospitalization, drugs, and physician, chiropractic and physiotherapy care. In addition, in almost all studies the reported costs were specific to low back pain prevention and care, rather than general costs for all conditions a person might have.

In some studies, the authors also included costs of work loss. Sometimes these were reported in terms of workers' compensation payments, and sometimes as the (wage related) value of lost time. Strictly speaking, the former is not an economic cost, because it is a payment to someone who is not working (i.e., a transfer payment rather than a payment for work that is actually done). Nevertheless, it seems that such a statistic, though not a direct measure of resource use is a reasonable approximation of lost production.

We should note that in this review we focus on total resource use rather than payer cost. If costs are divided between consumers and governments (because of co-payments) then the cost to the government is reduced. The government payment, then, does not reflect full resource cost.

The studies varied considerably in the statistical measure of cost. The most frequently used statistic was the mean or average cost per person. This is perhaps the most useful measure, and it is the measure recommended in economic studies (Drummond et al., 2000). However, because a large portion of low-back pain costs are concentrated in a small number of individuals, the information on the skewness of the sample, and on the number and cost of outliers, is pertinent. Some studies reported the median, which in conjunction with the mean, provides an indication of the impact of high cost cases.

Although the results were for different years and different currencies, we did not attempt to standardize all results into Canadian dollars for a single year. Studies were reported in US or Canadian Dollars (studies done in other currencies were translated into 2002 Canadian dollars). We were primarily interested in relative results. In many of the studies, the comparisons were internally consistent. However, we noted considerable differences between studies in a number of key elements, including the services included and the timelines of the study. We did not think that meaning would be added to the studies by standardizing for currency and time differences. There are at present, no good international purchasing power indexes for health care; and in Canada, there are no good health care inflation indexes.

Results

Papers reviewed

In our final sample, there were 32 distinct studies. We divided them into different groups. The first group contained randomized controlled trials under experimental conditions. These studies included Greenwood et al. (1990), Shi (1993), Malmivaara et al. (1995), Goossens et al. (1998), Cherkin et al. (1998), Moffett et al. (1999), Preyde (2000), Skargren et al. (2000), Cherkin et al. (2001), Kovacs et al. (2002), Loisel et al. (2002), Miller et al. (2002), and Skouen et al. (2002).

In all of these studies the study interventions were pre-defined. There was one randomized control trial in which the patients were randomized to actual treatments (Meade et al., 1990). There were 3 non-randomized studies with experimental interventions; these were Brown et al. (1992), Yassi et al. (1995), and McGuirk et al. (2001). There were 15 studies which were based on observation of non – controlled (actual) interventions; these were Greenwood (1985), Wolk (1988), Jarvis et al. (1991), Nyendo et al. (1991), Dean et al (1992), Stano et al. (1993), Carey et al. (1995), Shekelle et al. (1995), Stano et al. (1996), Katz et al. (1997), Muse and Associates (2001), Anderson et al. (2002), Kumer et al. (2002), MGT Inc. (2002), and Stano et al. (2002).

Of these Katz et al. (1997) and Kumer et al. (2002) focused on specific interventions for severe cases only. Even though these 32 were the highest quality studies, not all of them contained sufficient information to draw comparisons.

The cost of routine care

An overview of the basic cost is shown in Table 1. Here we present the monthly cost found in the highest quality papers. Even these results are not highly comparable. The wide variation, from \$30 to \$57 per month, can be due to any of the following: longer observation periods, differences in case severities between studies, and differences in unit costs of services and services provided in different countries. The lowest estimate (\$30 Canada) is an outlier in that the observation period is very long; if there were many acute cases in this sample, as seems the case, then the long observation period would bring down costs. The remainder of costs falls into the range of \$40 to \$60 per month. We used this range as a base statistic, against which to compare alternative interventions.

The cost of alternatives – review of selected studies

Three randomized controlled trials focused on chiropractic versus other types of care. In a Swedish study which lasted for twelve months and focused on patients in general practice, Skargren et al. (2000) observed that there was no difference in costs between chiropractic and physiotherapy patients; direct costs per month were CDN \$57 for both groups of patients under chiropractic and those receiving physiotherapy. Indirect (work loss) costs were about five times those of direct costs (CDN \$280 per month) for both groups. Cherkin et al. (1998) in a U.S. study noted no difference between costs of physiotherapy and chiropractic patients; over a period of 24 months, costs in both groups in a Health Maintenance Organization were about \$18 per month and much less for patients were only given a booklet. These costs are lower than in most other studies; one reason may be because co-payments existed, but were not reported. Co-payments may reduce demand and at the same time they should be counted as a relevant cost.

Meade et al. (1990) in a UK study also reported low costs, with chiropractic care being more costly over a 24 month period. However, the authors did not provide sufficient detail to determine which costs were included.

Of the observational studies which focused on alternative types of care, four provided results which we considered sufficiently transparent. All were U.S. studies. Carey et al. (1995) studying patients over twelve months concluded that low-back pain patients under, alternatively, chiropractic, medical doctor and Health Maintenance Organization (managed) care incurred costs of US\$65, \$42, and \$36 per month, respectively. The authors noted that chiropractic patients used more visits; they also noted that the number of visits per case was highly skewed between chiropractic providers, with a small number of chiropractors providing more intensive care. These results mirrored those of Greenwood et al. (1985). However, the observation times were not reported in this latter study, and so a monthly cost could not be calculated. Nyendo (1991) reported a monthly cost of US \$73 and \$44 for chiropractic and medical low-back pain cases over a period of 30 months. These authors noted that chiropractic cases were seen for longer periods,

and may be more chronic cases. They excluded crossover cases, some of which may have been severe cases which changed from chiropractic to medical care may have been excluded. Further, these cases were Workers Compensation claims, which are more serious than average. Stano et al. (1993) reported chiropractic care to be less costly (US \$79 versus \$111) than medical doctor care over a 24 month period; however the authors did not adjust for severe cases, which would fall into the medical category.

Among the randomized studies for other types of interventions, Loisel (2002), a Canadian study over an 88 month period reported monthly costs of \$30 for routine care and \$63, \$34 and \$63 for cases with clinical only, occupational only, and clinical plus occupational interventions. Goossens (1998) in a Netherlands study, reported monthly costs over a 12 month period of US \$90, \$47, and \$54 for exercise therapy plus personal counseling, exercise therapy plus group therapy, and routine care. In a three month study in Finland, Malmivaara et al. (1995) reported monthly costs of US\$48, \$55, and \$41 respectively for bed rest, exercise therapy and normal care; indirect (work loss) costs were \$78, \$132, and \$56 respectively. Greenwood et al. (1990), over an 18 month trial conducted through a US Workers' Compensation Program, reported costs of US \$164 and \$183 respectively for early intervention and routine care. These costs may be high because they exclude low severity cases.

Among the more transparent observational studies, Anderson et al. (2002) estimated monthly costs to be US \$94, \$80 and \$185 for general practitioner, general practitioner plus specialist, and specialist care. These three categories, especially the third, would appear to include cases with different severities. McGuirk et al. (2001) in an Australian study of the use of clinical guidelines reported monthly costs to be AU \$23 and \$39 for those who, respectively, were and were not in the guidelines group and over a twelve month period.

In a study of diagnostic interventions, Miller (2002) in a U.K. study found that the use of routine radiographies was associated with a cost per case of CDN \$114 per month compared with CDN \$100 for cases which did not use routine radiography. The timelines for this study were 9 months.

Conclusions

We conducted a survey of the literature of studies on alternative types of interventions and their effect on the cost of low-back pain. The studies were very diverse, both in topic and method. Nevertheless, we can draw some tentative conclusions from these results.

The health care costs of low-back pain for routine care vary from \$40 to \$60 per month. Using this "standard" as a basis, authors have observed the following:

- Under experimental conditions, chiropractic and general medical care cost about the same.
- In the studies reviewed which dealt with actual condition, the cost of chiropractic care was higher than medical doctor care. However we do not feel that the studies in general provide adequate information to uncover the causes of these differences.

- Secondary preventive programs are costly, and do not reduce the cost of general care sufficiently to result in savings. We have to note that preventive care should be studied with longer timelines, because prevention often has long-term effects.

None of these observations should be taken as providing sufficient evidence for or against one type of care or program; outcomes are also of importance. Further, we have taken a total resource perspective, rather than a payers perspective. Costs, from a government perspective, will change when there are direct consumer payments.

Gyldmark (1995) conducted an evaluation of intensive care unit costing studies, noting that very little could be concluded because investigators used widely varying and often inappropriate methods. The same might be said for costing studies of low-back pain. Methods differ widely, there is very little transparency, and the studies may include and exclude very different cases in this ambiguous condition. Some of these shortcomings, particularly the selection of cases, cannot be well controlled between studies, because of differences in the definition of cases. However, if reporting were more transparent, better comparisons could be made.

Table 1. Monthly cost of health care for routine low-back pain patients by country and observation time

Study	Location	Duration (months)	Average Cost / Month
Goossens ME et al.	Netherlands	12	US \$54
Nyiendo J.	USA	30	US \$44
Carey TS et al.	USA	12	US \$42
Malmivaara A et al.	Finland	3	US \$41
Skargren EI et al.	Sweden	12	CDN \$57
Loisel et al.	Canada	88	CDN \$30

References

- Acute Low Back Pain Guide. New Zealand: ACC (Accident Rehabilitation and Compensation Insurance Corporation), and National Health Committee, 1997.
- Low-Back Pain: Frequency, Management and Prevention from an HTA perspective. Copenhagen: Danish Institute for Health Technology Assessment; National Board of Health, 1999.
- Anderson JJ et al. Relative costs and effectiveness of specialist and general internist ambulatory care for patients with 2 chronic musculoskeletal conditions. *J Rheumatol.* 2002;29:1488-95.
- Andersson GBJ et al. Epidemiology and cost. Occupational low back pain. St. Louise: Mosby-Year Book, 1991.
- Brown KC et al. Cost-effectiveness of a back school intervention for municipal employees. *Spine* 1992;17:1224-8.
- Canadian Coordinating Office for Health Technology Assessment (CCOHTA). Guidelines for economic evaluation of pharmaceuticals: CANADA. Ottawa: 1997.
- Carey TS et al. The outcomes and costs of care for acute low back pain among patients seen by primary care practitioners, chiropractors, and orthopedic surgeons. The North Carolina Back Pain Project. *N.Engl.J Med* 1995;333:913-7.
- Cherkin DC et al. A comparison of physical therapy, chiropractic manipulation, and provision of an educational booklet for the treatment of patients with low back pain. *N.Engl.J Med* 1998;339:1021-9.
- Cherkin DC et al. Randomized trial comparing traditional Chinese medical acupuncture, therapeutic massage, and self-care education for chronic low back pain. *Arch.Intern.Med* 2001;161:1081-8.
- Dean DH, Schmidt RM. A comparison of the costs of chiropractors versus alternative medical practitioners. 1-51. 1-13-1992. *Bureau of Disability Economics Research. Robins School of Business. University of Richmond.*
- Drummond MF et al. Methods for the economic evaluation of health care programmes. Oxford University Press, 1997.
- Fautrel B, Guillemin F. Cost of illness studies in rheumatic diseases. *Curr.Opin.Rheumatol.* 2002;14:121-6.
- Fischbacher C. Outpatient physiotherapy services for low back pain. 1-8. 2002. The Wessex Institute for Health Research & Development.
- Frymoyer JW, Cats-Baril WL. An overview of the incidences and costs of low back pain. *Orthop.Clin.North Am.* 1991;22:263-71.
- Furlan AD et al. Massage for low-back pain: a systematic review within the framework of the Cochrane Collaboration Back Review Group. *Spine* 2002;27:1896-910.
- Giles LG. Re: Safety, efficacy, and cost-effectiveness of evidence-based guidelines for the management of acute low back pain in primary care (*Spine* 2001;26:2615-22). *Spine* 2002;27:1592-4.
- Goossens ME et al. Health economic assessment of behavioural rehabilitation in chronic low back pain: a randomised clinical trial. *Health Econ.* 1998;7:39-51.

- Goossens ME et al. The cost diary: a method to measure direct and indirect costs in cost-effectiveness research. *J Clin.Epidemiol.* 2000;53:688-95.
- Goossens MEJB, Evers SMAA. Economic evaluation of back pain interventions. *Journal of Occupational Rehabilitation* 1997;7:15-31.
- Grazier KL, Kelsey JL, Holbrook TL. The Frequency of Occurrence, Impact, and Cost of Musculoskeletal Conditions in the United States. American Academy of Orthopaedic Surgeons, 1984.
- Greenwood JG. Work-Related back and neck injury cases in West Virginia. *Orthopedic Review* 1985;14:51-63.
- Greenwood JG et al. Early intervention in low back disability among coal miners in West Virginia: negative findings. *J Occup.Med* 1990;32:1047-52.
- Gyldmark M. A review of cost studies of intensive care units: problems with the cost concept. *Crit Care Med* 1995;23:964-72.
- Hashemi L, Webster BS, Clancy EA. Trends in disability duration and cost of workers' compensation low back pain claims (1988-1996). *J Occup.Environ.Med* 1998;40:1110-9.
- Jarvis KB, Phillips RB, Morris EK. Cost per case comparison of back injury claims of chiropractic versus medical management for conditions with identical diagnostic codes. *J Occup.Med* 1991;33:847-52.
- Johnson MR, Schultz MK, Ferguson AC. A comparison of chiropractic, medical and osteopathic care for work-related sprains and strains. *J Manipulative Physiol Ther.* 1989;12:335-44.
- Katz JN et al. Lumbar laminectomy alone or with instrumented or noninstrumented arthrodesis in degenerative lumbar spinal stenosis. Patient selection, costs, and surgical outcomes. *Spine* 1997;22:1123-31.
- Kovacs FM et al. Effectiveness and cost-effectiveness analysis of neuroreflexotherapy for subacute and chronic low back pain in routine general practice: a cluster randomized, controlled trial. *Spine* 2002;27:1149-59.
- Kumar K, Hunter G, Demeria DD. Treatment of chronic pain by using intrathecal drug therapy compared with conventional pain therapies: a cost-effectiveness analysis. *J Neurosurg.* 2002;97:803-10.
- Kumar K, Malik S, Demeria D. Treatment of chronic pain with spinal cord stimulation versus alternative therapies: cost-effectiveness analysis. *Neurosurgery* 2002;51:106-15.
- Loisel P et al. Cost-benefit and cost-effectiveness analysis of a disability prevention model for back pain management: a six year follow up study. *Occup.Environ.Med* 2002;59:807-15.
- Maetzel A, Ferraz MB, Bombardier C. A review of cost-effectiveness analyses in rheumatology and related disciplines. *Curr.Opin.Rheumatol.* 1998;10:136-40.
- Malmivaara A et al. The treatment of acute low back pain--bed rest, exercises, or ordinary activity? *N.Engl.J Med* 1995;332:351-5.
- Malter AD et al. Cost-effectiveness of lumbar discectomy for the treatment of herniated intervertebral disc. *Spine* 1996;21:1048-54.

- Manga P et al. The effectiveness and cost-effectiveness of chiropractic management of low-back pain. Ottawa, Canada: 1993.
- McGuirk B et al. Safety, efficacy, and cost effectiveness of evidence-based guidelines for the management of acute low back pain in primary care. *Spine* 2001;26:2615-22.
- McKinley DS, Shaffer LM. Cost effectiveness evaluation of ADCON-L adhesion control gel in lumbar surgery. *Neurol.Res.* 1999;21 Suppl 1:S67-S71.
- Meade TW et al. Low back pain of mechanical origin: randomised comparison of chiropractic and hospital outpatient treatment. *BMJ* 1990;300:1431-7.
- MGT of America I. Trends in chiropractic treatment of workers' compensation claimants in the state of Florida (Final Report). 1-28-2002. MGT of America, Inc.
- Miller P et al. Cost-effectiveness of lumbar spine radiography in primary care patients with low back pain. *Spine* 2002;27:2291-7.
- Moffett JK et al. Randomised controlled trial of exercise for low back pain: clinical outcomes, costs, and preferences. *BMJ* 1999;319:279-83.
- Muse & Associates. Utilization, Cost, and Effects of Chiropractic Care on Medicare Program Costs. 1-31. 2001. The American Chiropractic Association (ACA).
- Nyiendo J. Disabling low back Oregon workers' compensation claims. Part III: Diagnostic and treatment procedures and associated costs. *J Manipulative Physiol Ther.* 1991;14:287-97.
- Nyiendo J, Lamm L. Disabling low back Oregon workers' compensation claims. Part I: Methodology and clinical categorization of chiropractic and medical cases. *J Manipulative Physiol Ther.* 1991;14:177-84.
- Preyde M. Effectiveness of massage therapy for subacute low-back pain: a randomized controlled trial. *CMAJ.* 2000;162:1815-20.
- Rosner AL. Comparing the costs between provider types of episodes of back pain care. *Spine* 1995;20:2595-8.
- Shekelle PG, Markovich M, Louie R. Comparing the costs between provider types of episodes of back pain care. *Spine* 1995;20:221-6.
- Shi L. A cost-benefit analysis of a California county's back injury prevention program. *Public Health Rep.* 1993;108:204-11.
- Skargren EI, Carlsson PG, Oberg BE. One-year follow-up comparison of the cost and effectiveness of chiropractic and physiotherapy as primary management for back pain. Subgroup analysis, recurrence, and additional health care utilization. *Spine* 1998;23:1875-83.
- Skouen JS et al. Relative cost-effectiveness of extensive and light multidisciplinary treatment programs versus treatment as usual for patients with chronic low back pain on long-term sick leave: randomized controlled study. *Spine* 2002;27:901-9.
- Smith M, Stano M. Costs and recurrences of chiropractic and medical episodes of low-back care. *J Manipulative Physiol Ther.* 1997;20:5-12.

Solomon DH et al. Costs, outcomes, and patient satisfaction by provider type for patients with rheumatic and musculoskeletal conditions: a critical review of the literature and proposed methodologic standards. *Ann.Intern.Med* 1997;127:52-60.

Stano M. A comparison of health care costs for chiropractic and medical patients. *J Manipulative Physiol Ther.* 1993;16:291-9.

Stano M, Smith M. Chiropractic and medical costs of low back care. *Med Care* 1996;34:191-204.

Stano M et al. Chiropractic and medical care costs of low back care: results from a practice-based observational study. *Am.J Manag.Care* 2002;8:802-9.

Wolk S. An analysis of Florida workers' compensation medical claims for Back-Related injuries. 1-21. 2-17-1988. The Foundation for Chiropractic Education and Research.

Wolk S. Chiropractic versus medical care: A cost analysis of disability and treatment for Back-Related workers' compensation cases. 1-22. 1988. The Foundation for Chiropractic Education and Research.

Yassi A et al. Early intervention for back-injured nurses at a large Canadian tertiary care hospital: an evaluation of the effectiveness and cost benefits of a two-year pilot project. *Occup.Med (Lond)* 1995;45:209-14.

Acknowledgements

We would like to thank Dr. J. Pfaff for advice in conducting our reviews.