Spinal manipulation epidemiology

Systematic review of cost effectiveness studies

Michaleff, Z. A.; Lin, C. W.C.; Maher, C. G.; van Tulder, M. W.

Published in:
Journal of Electromyography and Kinesiology

DOI:
10.1016/j.jelekin.2012.02.011

INTRODUCTION

Spinal pain, including neck pain and back pain, is a prevalent condition in modern society [1, 2]. It presents major social and economic burdens due to the high levels of chronicity and resultant long term disability which are associated with high costs in health care and losses of productivity (e.g. sick leave) [1]. While existing practice guidelines inform the individual, clinicians and policy makers on the effectiveness of a range of interventions, few provide information on the *cost-effectiveness* of treatments. It is arguable that cost-effectiveness of treatment is an equally important consideration as effectiveness, as all health systems need to make decisions about how they allocate scarce health resources.

An economic evaluation involves the identification, measurement, valuation and then comparison of the costs and consequences (benefits) of two or more alternative treatments [3]. Economic evaluations are most useful when the treatments under question have been evaluated in terms of efficacy (can the treatment work in those who comply with the recommendations), effectiveness (is the treatment acceptable and does the treatment work in those who the treatment is offered) and availability (is the treatment accessible to all who would benefit from it). While economic evaluations are frequently conducted alongside a randomised controlled trial of treatment effectiveness, it is only when the effect of the treatment is known can the appropriate economic technique then be applied to make comparisons between treatments in terms of costs and benefit or "value for money" [3]. Therefore, the result of an economic evaluation provides a complementary perspective beyond the current evidence base of treatment effectiveness alone that can be used to inform consumers, insurers, governments and policy makers where the health budget should be spent.

Spinal manipulative therapy (SMT), including both manipulation (a high velocity thrust technique) and mobilisation (low velocity technique), is frequently used by a number of health professions, including physiotherapists, chiropractors and osteopaths, to manage people with neck pain and back pain [4, 5]. The effectiveness of SMT to treat spinal pain has been summarised in recent Cochrane Reviews [4-6]. Overall the evidence suggests that SMT provides greater improvements for pain and function than a placebo or no treatment but similar improvements to many competing treatments such as general practitioner management, medication and exercise. With many treatments for spinal pain

having comparable outcomes to SMT, determining the cost effectiveness of these treatment alternatives has been identified as a high priority [6]. The purpose of this systematic review is to investigate the cost-effectiveness of SMT compared to other treatment options for people with spinal pain of any duration.

METHODS

We followed the method guidelines of the Cochrane Back Review Group [7, 8], Campbell and Cochrane Economic Methods Group (http://www.med.uea.ac.uk/research/research_econ/cochrane/cochrane_home.htm), and the NHS Economic Evaluation Database Handbook [9]. Full economic evaluations (i.e. cost-minimisation, cost-effectiveness, cost-utility or cost-benefit analysis) undertaken from any perspective conducted alongside randomised controlled trials were included in this review. There is debate as to the strength of cost-minimisation studies compared to the other types of economic evaluations due to the often inappropriate use of this methodology in situations where clinical equivalence does not exist or trials are inadequately powered to detect differences between treatments [3, 10, 11]. To avoid publication bias and to ensure that this review provides a comprehensive summary of the literature, cost-minimisation studies were eligible for inclusion if they met the inclusion criteria. Studies which collected data on costs and/or utilisation but did not relate this information to a measure of benefit, or did not make inferences about the relative efficiency of the treatment alternatives, were excluded. Studies that recruited adults with non-specific spinal (neck or back) pain (i.e. pain is not the result of an accident, trauma or specific spinal pathology) of any duration, reported costs and effects of the interventions and included SMT in at least one intervention group were eligible for this review. We included studies where SMT was administered as the only intervention or as a mandatory component of a combined intervention. No restrictions were placed on the type of health professional performing the interventions or the comparison group used. Studies that recruited multiple musculoskeletal conditions (e.g. neck and shoulder pain), or investigated interventions implemented after spinal surgery were excluded. There was no language restriction.

Data sources and searches

Studies evaluating the cost-effectiveness of SMT for spinal pain were identified from the reference lists of three systematic reviews on the cost-effectiveness of neck pain and back pain treatments [12-14]. Because these reviews were conducted exclusively for neck *or* back pain, we also screened the articles which were excluded after full-text screening, in case if any study was excluded due to including both neck *and* back pain. An electronic database search was also conducted on MEDLINE (via OvidSP), EMBASE (via OvidSP), CINAHL (via EBSCO), the American Economic Association's electronic bibliography (EconLit), National Health System Economic Evaluation Database (NHS EED), and European Network of Health Economic Evaluation Databases (EURONHEED) to identify studies published since the previous literature searches were completed (June 2010 to July 2011). Economic search terms (e.g. economics, costs and cost analysis) were developed from search strategies used by the NHS EED (http://www.york.ac.uk/inst/crd/nhseedfaq02.htm) and combined with the Cochrane Back Review Group's search strategy to identify randomised controlled trials in neck pain and back pain [15]. See Appendix 1 for an example of a full search strategy.

Study selection, risk of bias assessment and data extraction

Two reviewers independently screened first the titles and abstracts (if available), and then full papers. Risk of bias was assessed using the 19-item Consensus on Health Economic Criteria (CHEC-list) [16]. Studies were included in the analysis regardless of their risk of bias. Data were extracted using a standardised data extraction sheet which was piloted on a cost-effectiveness study [17] before use. The risk of bias rating and data extraction were conducted by two reviewers. Publications related to the included studies (e.g. published protocol or clinical outcomes paper, listed in Appendix 2) were used to assist these processes. Throughout the review, disagreements between the two reviewers were resolved first in discussion, and then by an independent third reviewer if necessary.

Data extracted from each study included: (i) the type and perspective of the economic evaluation, (ii) characteristics of participants, (iii) treatment comparators, (iv) year, study duration, country and currency of the study, and (v) identification, measurement and valuation of costs and outcomes used in the economic evaluation, and (vi) results of the study. The primary outcome used was the relative cost-effectiveness of the interventions, usually reported as an incremental cost-effectiveness or cost-utility ratio (ICER). The ICER indicates the incremental difference in costs between the competing

treatment alternatives relative to the incremental difference in effects, and can be interpreted as the additional monetary investment needed for an intervention to gain one extra unit of effect compared to the alternative treatment [3]. Whether the effects are worth the costs (value for money), is the key question in economic evaluations, which often triggers intense debate. In some countries consensus exists about thresholds for cost-effectiveness. For example, the British National Institute for Health and Clinical Excellence (NICE) uses a cost-effectiveness threshold of GBP20,000 to GBP30,000 per QALY gained as an indicator of cost-effectiveness [18, 19]. In other countries no threshold exists leading to difficult discussions about whether an intervention is cost-effective or not. When one treatment incurs lower costs and generates higher benefits compared to the alternative treatment, the treatment is said to be dominant. In these cases there will not be a big debate about the interpretation of the results and the choice will be in favour of the dominant treatment.

For data analysis and presentation, studies were grouped by the intervention that SMT was compared to and then the affected region (neck or back). Studies reporting ICER using generic outcomes (e.g. cost per quality-adjusted life-years (QALYs) gained) from the same perspective were compared as able. We used the cost-effectiveness threshold of NICE (see above) as an indicator of cost-effectiveness [18, 19]. That is, if a treatment has an ICER lower than the NICE threshold when compared to an alternative, the treatment is said to be cost-effective compared with the alternate treatment.

RESULTS

The search yielded 95 references; 48 references were identified through the electronic database search and 55 references from the three previous systematic reviews [12-14]. A total of eight studies were included after screening (Figure 1). Most full papers were excluded because they did not evaluate SMT. All of the included studies were designed as a randomised controlled trial and published in English. The number of participants in each study ranged from 146 [20] to 1,334 [21]. Characteristics of the included studies can be seen in table 1.

Four studies reported on the cost-effectiveness of interventions for LBP, 3 studies reported on neck pain and one reported on a mixed neck and LBP population. The duration of neck and LBP symptoms

varied between studies with the majority recruiting people with acute and sub-acute pain (≥ 2 weeks – 12 weeks). The duration of symptoms was not specified in two studies [22, 23]. Six studies conducted both cost-effectiveness and cost-utility analyses [20, 21, 23-26], while the remaining two studies conducted a cost-minimisation analysis [22, 27] .The economic analysis was conducted from a societal perspective in three studies [20, 24, 25], healthcare perspective in two studies [21, 26], one study from both the societal and healthcare perspective [23] and the perspective was not specified in the two cost-minimisation studies [22, 27]. SMT was delivered by physiotherapists, chiropractors and osteopaths with treatments often involving a combination of manipulation, mobilisation (active or passive) and advice. On average patients received one 20-40 minute session once per week for 4 to 6 weeks.

Risk of bias of the economic evaluation (Table 2)

Six studies scored 16 or more out of 19 on the CHEC-list. The two cost-minimisation studies were found to be of lower methodological quality due to a number of items not being applicable to the economic evaluation [22, 27]; consequently it is suggested that the findings of these studies be interpreted with caution. Two studies did not state the economic perspective adopted [22, 27] and one study did not justify the perspective chosen [21]. Discounting was not applicable in six studies and was not performed by the two studies which had a follow up duration of longer than 12 months [22, 24]. Two of 8 studies performed appropriate sensitivity analyses [21, 25]. An incremental cost-effectiveness analysis was conducted by all six of the cost-effectiveness and cost-utility studies, and five studies presented cost-effectiveness planes [20, 23-26].

COST-EFFECTIVENESS OF SMT

SMT compared to GP care

Three studies investigated the cost-effectiveness of SMT versus general practitioner (GP) care (advice, education and drug prescription). The results of two cost-minimisation studies in LBP (economic perspective not specified) showed that when direct costs alone were considered SMT was associated with higher costs than GP care [22, 27](Table 3). However, the differences in total costs over one year appeared small as SMT was associated with lower indirect costs (total cost in Swedish crowns, price year not stated, for SMT = 49,076, GP care = 50,834) [27]. The small difference in total

cost should be interpreted with caution as this study had incomplete cost identification (only the costs of study treatment, investigations and operations were collected as the direct costs) and again had a high risk of bias.

In patients with neck pain, Korthals-De-Bos et al [25] demonstrated SMT to be dominant over GP care, from a societal perspective, in terms of recovery and quality of life, as SMT was associated with lower total costs and higher rates of recovery. Interestingly, no difference was shown in the cost-effectiveness of SMT versus GP care for pain intensity and functional disability [25] which are the outcomes typically selected to judge effectiveness of SMT.

SMT compared to exercise

Three studies investigated the cost-effectiveness of SMT versus exercise. Seferlis et al [27] reported SMT to incur 3653 Swedish crowns (SEK) more than an intensive exercise program for LBP (total cost in Swedish crowns, price year and perspective not stated, for SMT = 49,076, Exercise = 45,423). The exercise program was associated with higher direct costs due to patients receiving more treatment sessions (SMT: 8.8 vs. Ex: 15.9) however lower indirect costs as people in this group had fewer days off work [27].

Two studies adopting a societal perspective reported on SMT versus exercise in patients with neck pain [20, 25]. Both studies found SMT to be a cost-effective treatment option compared to an exercise program in terms of pain, recovery and QALY gains (Table 4). The cost-effectiveness plane by Korthals-de-Bos et al [25]showed 98% of the cost-effect pairs for pain located in the South East quadrant suggesting that SMT is dominant compared with exercise.

SMT compared to other treatment

The cost-minimisation study by Kominski et al compared SMT to SMT plus physical modalities (heat, cold, ultrasound) as well as SMT to GP care plus physiotherapy (e.g. physical modalities, massage, exercise, additional treatments were used at the discretion of the physiotherapist) [22]. While the economic perspective is unclear SMT alone was the least costly treatment option; the addition of physical modalities to SMT resulted in a marginal increase in treatment costs (13.5%). GP care plus

physiotherapy was the most costly treatment option being 24.5% more expensive than SMT alone (Table 5).

SMT plus GP care compared to other

Two studies reported on the cost-effectiveness of SMT plus GP care compared to GP care alone in LBP [21] or neck and LBP [26]; in addition one of the studies also compared SMT plus GP to GP care plus exercise [21]. From a UK health care perspective both trials found SMT plus GP care to be a cost-effective treatment compared to GP care alone as both ICERs fell below the NICE threshold (GBP 20 000 to GBP30,000 per QALY gained) despite the different pain regions being under investigation (Williams et al: ICER £3560 per QALY gained in 1999/2000 GBP; UK BEAM Trial Team: ICER = £4800 per QALY gained in 2000/2001 GBP). SMT plus GP care was also shown to be a cost-effective treatment when compared to GP care plus exercise with an ICER of £2300 per QALY gained in 2000/2001 GBP. Table 6.

SMT plus other treatment compared other

Three studies investigated the cost-effectiveness of a combined treatment approach, which involved SMT plus advice (delivered by a physiotherapist or GP) and exercise (Table 7). Two studies, one from a societal perspective [24] and the other from a health sector perspective [21], compared the combined treatment approach to GP care alone [21, 24]. From a societal perspective, Niemisto et al [24] found no difference between groups in terms of quality of life however the data suggest that the combined treatment incurred lower annual costs compared to GP care alone. With respect to pain and disability outcomes the data suggested the combined treatment was dominant over GP care alone however this was not supported by the conclusions made by the authors. From a healthcare perspective the UK BEAM Trial found the combined treatment to be cost-effective over GP care alone with a low ICER (£3800 per QALY gained in 2000/2001 GBP).

For people with neck pain the most cost-effective treatment was dependant on the perspective, societal or health sector, and of the threshold for willingness to pay. Advice and exercise was generally more cost-effective in terms of changes to neck disability scores from both a societal and healthcare perspective. In terms of QALY gained the combined approach was more cost-effective

from a societal perspective however from a healthcare perspective there was more uncertainty as to the most cost-effective treatment with SMT appearing slightly more advantageous. [23].

DISCUSSIONS

Eight economic evaluations were included in this systematic review which evaluated the cost-effectiveness of SMT compared to other treatment options for people with neck and back pain. The studies conducted in back pain were primarily UK studies conducted from a health sector perspective, while the studies in neck pain were Dutch and Finnish studies from a societal perspective. Regardless of the perspective employed or the region of pain, SMT appears to be a cost-effective treatment when used alone or in combination with GP care or advice and exercise compared to GP care alone, exercise or any combination of these. The findings of the two cost-minimisation studies suggest that SMT incurs higher direct treatment costs however when considering total costs (direct and indirect) SMT was equivalent to GP, exercise, GP plus physiotherapy.

The findings of this review have important clinical, research and policy implications. Clinically, SMT is a treatment technique frequently used by a number of health professionals to manage neck and back pain. Based on all available literature, this review supports the use of SMT in clinical practice as a cost-effective treatment when used alone or in combination with other treatment approaches. In some studies SMT was also shown to be less costly per unit gained when compared to education, exercise, physical modalities and GP care. These results are applicable to clinicians, who make recommendations about treatment options, as well to health consumer who wish to make informed decision about available health care options.

From a research perspective this review highlights the need for more high quality economic evaluations to be conducted alongside randomised controlled trials of treatment effectiveness. While this review summarised the available literature, due to a limited number of studies with heterogeneous populations, perspectives, settings and analyses it was not possible to pool the results of included studies. This resulted in a number of conclusions as to the cost-effectiveness of SMT for neck or back pain to be based on one study alone. Systematic reviews of randomized controlled trials have shown that results of one study are often not reliable and precise. There is no reason to believe that this

would be different for economic evaluations, especially because sample sizes of economic evaluations are often (too) small, and that economic consequences differ across different health settings. Of the comparisons supported by two studies it is worth noting the agreement between the studies which increases the robustness of the conclusions which can be made. For example, a comparable ICER was reported by Williams et al [26] and the UK Beam Trial [21] when SMT plus GP care was compared to GP care alone despite the different pain regions and price years reported.

A number of tools are available to assess the risk of bias of economic evaluations (e.g. CHEC-List [16], BMJ Check-list [28] and The Quality of Health Economic Studies instrument [29]) and investigate the level of uncertainty in cost-effectiveness estimates e.g. cost-effectiveness acceptability curves (CEACs). The CHEC-List was applied in this study based on the 19-item check list generated through consensus of 23 international experts in a Delphi method [16]. In general, the economic evaluations included in this study were of low risk of bias with 6 out of the 8 included studies scoring ≥ 16 out of 19 on the CHEC-List. The key item identified for improvement in future studies is the inclusion of a sensitivity analysis (Item 15), as only 2 of the 8 included studies performed an adequate analysis. Sensitivity analyses systematically deal with the level of uncertainty around the results and should be an essential component in all economic evaluations to assess the robustness of the conclusions made [30, 31]. While not included as an item in the CHEC-List, future studies should also consideration the inclusion of CEACs. CEACs provide a visual summary of the probability that an intervention is more cost effective than its comparator and can also incorporate important cost information such as willingness to pay [3, 32].

Economic evaluations are an essential consideration to inform and support health care and funding decision made by insurers, governments and policy developers. In treatments for spinal pain, as in the case of SMT, effectiveness studies are often able to demonstrate treatment effects when compared to no treatment, but fail to demonstrate which active treatment is more effective [4, 6]. The findings of this review show that while the treatment effectiveness of SMT is comparable to other treatments SMT is a cost-effective treatment option. Furthermore, this review found the most effective treatment or the least costly treatment to not always be the most cost-effective treatment. This

demonstrates the valuable information that can be provided by economic evaluations beyond results of effectiveness alone and supports the need for more economic evaluation to be conducted.

This systematic review found SMT to be a cost-effective treatment to manage spinal pain when used alone or in combination with GP care or advice and exercise compared to GP care alone, exercise or any combination of these. The findings were primarily based on single studies conducted in the UK and the Netherlands. More high quality studies can support whether the findings of this review are applicable in other settings.

Acknowledgements:

We would like to thank Maurice Driessen for the assistance on this review. ZAM hold an Australian Government funded Postgraduate Award, CGM holds a research fellowship from the Australian Research Council, CCL holds a research fellowship from the National Health and Medical Research Council of Australia.

Conflict of interest:

The authors declare that they have no competing interests.

REFERENCES:

1. Woolf A, Pfleger B. Burden of major musculoskeletal conditions. Bulletin of the World Health Organization. 2003;81(9):646-56.

2. Côté P, Cassidy J, Carroll L. The epidemiology of neck pain: what we have learned from our population-based studies. Journal of the Canadian Chiropractic Association. 2003;47(4):284-90.

3. Drummond MF, Sculpher MJ, Torrance GW. Methods for the economic evaluation of health care programmes. 3rd Edition ed: Oxford University Press; 2005.

4. Gross A, Miller J, D'Sylva J, Burnie S, Goldsmith C, Graham N, et al. Manipulation or Mobilisation for Neck Pain. Cochrane Database Syst Rev. 2010;1).

5. Assendelft W, Morton S, Yu E, Suttorp M, PG S. Spinal manipulative therapy for low-back pain. Cochrane Database Syst Rev. 2004;1).

6. Rubinstein S, van Middelkoop M, Assendelft W, de Boer M, van Tulder M. Spinal manipulative therapy for chronic low-back pain. Cochrane Database Syst Rev. 2011.

7. van Tulder M, Furlan A, Bombardier C, Bouter L, Editorial Board of the Cochrane Collaboration Back Review Group. Updated method guidelines for systematic reviews in the Cochrane Collaboration Back Review Group. Spine. 2003;28(12):1290-9.

8. Furlan AD, Pennick V, Bombardier C, van Tulder M, Editorial Board Cochrane Back Review Group. 2009 updated method guidelines for systematic reviews in the Cochrane Back Review Group. Spine. 2009;34(18):1929-41.

9. Craig D, Rice S. CRD Report 6: NHS Economic Evaluation Database Handbook. 3rd ed. York: Centre for Reviews and Dissemination, University of York; 2007.

10. Briggs A, O'Brien B. The death of cost-minimization analysis? Health Economics. 2001;10(2):179-84.

11. Haycox A, Walker A. What is cost-minimisation analysis. UK2009 [cited 2012 8/02/12]; Available from: www.whatisseries.co.uk.

12. Lin C, Haas M, Maher C, Machado L, Van Tulder M. Cost-effectiveness of general practice care for low back pain: a systematic review. European Spine Journal. 2011;1):1-12.

13. Lin C, Haas M, Maher C, Machado L, van Tulder M. Cost-effectiveness of guideline-endorsed treatments for low back pain: a systematic review European Spine Journal 2011;20(7):1024-38.

14. Driessen M, Lin C, van Tulder M. Cost-effectiveness of conservative treatments for neck pain: a systematic review on economic evaluations Submitted.

15. Bombardier C, van Tulder M, Brønfort G, Deyo R, de Bie R, Guillemin F, et al. About The Cochrane Collaboration (Cochrane Review Groups (CRGs). 2011;Issue 2).

16. Evers S, Goossens M, de Vet H, van Tulder M, Ament A. Criteria list for assessment of methodological quality of economic evaluations: Consensus on Health Economic Criteria. Int J Technol Assess Health Care. 2005;21(2):240-5.

17. Manca A, Epstein DM, Torgerson DJ, Klaber Moffett JA, Coulton S, Farrin AJ, et al. Randomized trial of a brief physiotherapy intervention compared with usual physiotherapy for neck pain patients: cost-effectiveness analysis. Int J Technol Assess Health Care. 2006;22(1):67-75.

18. Appleby J, Devlin N, Parkin D. NICE's cost effectiveness threshold. BMJ. 2007;335(7616):358-9.

19. Towse A. Should NICE's threshold range for cost per QALY be raised? Yes. BMJ. 2009;338(b181.

20. Bosmans JE, Pool, J.J., de Vet, H.C., van Tulder, M.W., Ostelo, R.W. Is behavioral graded activity cost-effective in comparison with manual therapy for patients with sub-acute neck pain? An economic evaluation alongside a randomized clinical trial. Spine (Phila Pa 1976). 2011;accepted for publication (

21. UK BEAM Trial Team. United Kingdom back pain exercise and manipulation (UK BEAM) randomised trial: cost effectiveness of physical treatments for back pain in primary care. BMJ. 2004;329(7479):1381-5.

22. Kominski G, Heslin K, Morgenstern H, Hurwitz E, Harber P. Economic evaluation of four treatments for low-back pain: results from a randomized controlled trial. Medical Care 2005;43(5):428-35

23. Lewis M, James M, Stokes E, Hill J, Sim J, Hay E, et al. An economic evaluation of three physiotherapy treatments for non-specific neck disorders alongside a randomized trial. Rheumatology (Oxford). 2007;46(11):1701-8.

24. Niemisto L, Rissanen P, Sarna S, Lahtinen-Suopanki T, Lindgren K-A, H H. Cost-effectiveness of combined manipulation, stabilizing exercises, and physician consultation compared to physician consultation alone for chronic low back pain: a prospective randomized trial with 2-year follow-up. Spine. 2005;30(10):1109-15

25. Korthals-de Bos IB, Hoving JL, van Tulder MW, Rutten-van Molken MP, Ader HJ, de Vet HC, et al. Cost effectiveness of physiotherapy, manual therapy, and general practitioner care for neck pain: economic evaluation alongside a randomised controlled trial. BMJ. 2003;326(7395):911.

26. Williams N, Edwards R, Linck P, Muntz R, Hibbs R, Wilkinson C, et al. Cost-utility analysis of osteopathy in primary care: results from a pragmatic randomized controlled trial. Family practice. 2004;21(6):643-50.

27. Seferlis T, Lindholm L, Nemeth G. Cost-minimisation analysis of three conservative treatment programmes in 180 patients sick-listed for acute low-back pain. Scandinavian Journal of Primary Health Care. 2000;18(1):53-7.

28. Drummond M, Jefferson T. Guidelines for authors and peer reviewers of economic submissions to the BMJ. BMJ. 1996;313(275-83.

29. Chiou C, Hay J, Wallace J, Bloom B, Neumann P, Sullivan S, et al. Development and validation of a grading system for the quality of cost-effectiveness studies. Medical Care. 2003;41(32-44.

30. van der Roer N, Goossens ME, Evers SM, van Tulder MW. What is the most cost-effective treatment for patients with low back pain? A systematic review. Best Pract Res Clin Rheumatol. 2005;19(4):671-84.

31. Briggs A, Sculpher M, Buxton M. Uncertainty in the economic evaluation of health care technologies: the role of sensitivity analysis. Health Economics. 1994;3(2):95-104.

32. Fenwick E, O'Brien B, Briggs A. Cost-effectiveness acceptability curves - facts, fallacies and frequently asked questions. Health Economics 2004;13(5):405-15.